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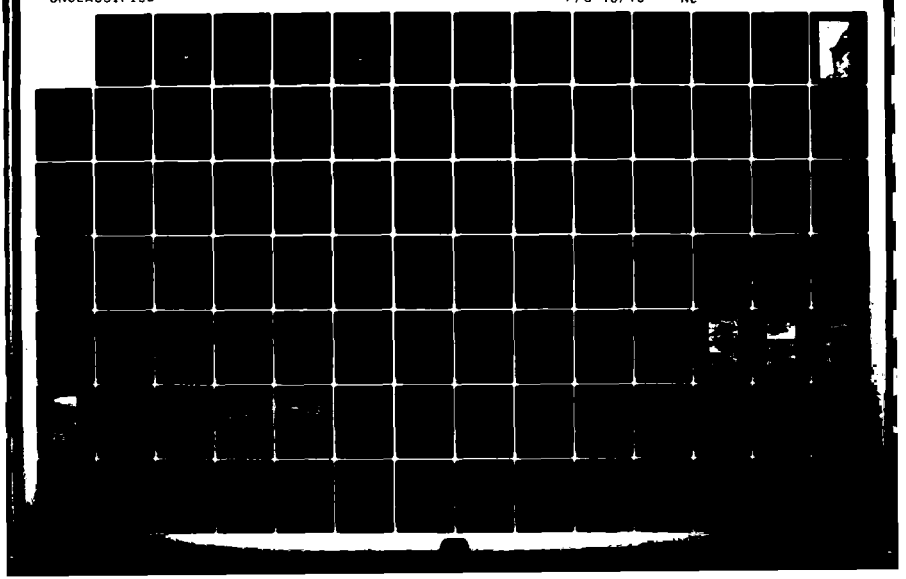

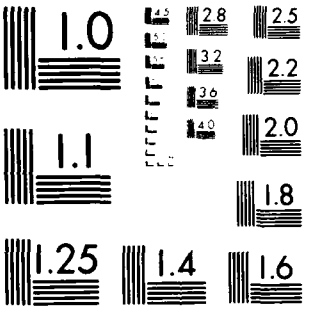

CONNECTICUT COASTAL BASIN
WALLINGFORD, CONNECTICUT

MAC KENZIE RESERVOIR DAM
CT 00037

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST, 1979

SECURITY UNCLASSIFIED CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle) Conn. Coastal Basin Wallingford, Conn Mac Kenzie Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
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9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE August 1979 13. NUMBER OF PAGES 92
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18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,

Conn. Coastal Basin Wallingford, Conn.
Mac Kenzie Reservoir Dam

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The 425 ft. long dam. built in 1944, is an earthfill embankment with a concrete corewall, concrete spillway and a concrete gatehouse. The earth embankment is 280 ft. long and the concrete structures, which include the spillway weir and the intake chamber, are 145 ft. in length. The earthfill embankment is 10 ft. wide at the top and 30 ft. above the streambed of the Muddy River. The spillway is a 90 ft. long concrete ogee weir with a concrete apron and a short stone paved discharged channel. Freeboard above the spillway weir crest is 5 ft.. The gatehouse, adjacent to the right side of the spillway, is a concrete intake chamber with a screened opening for a 24 inch low level outlet.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED

NOV 28 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the MacKenzie Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, town of Wallingford.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

CONNECTICUT COASTAL BASIN
WALLINGFORD, CONNECTICUT

MAC KENZIE RESERVOIR DAM
CT 00037

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

AUGUST, 1979

A-1

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	MACKENZIE RESERVOIR
Inventory Number:	CT-00037
State Located:	CONNECTICUT
County Located:	NEW HAVEN
Town Located:	WALLINGFORD
Stream:	MUDDY RIVER
Owner:	TOWN OF WALLINGFORD, WATER AND SEWER DEPT.
Date of Inspection:	MAY 2, 1979 and AUGUST 9, 1979
Inspection Team:	PETER M. HEYNEN, P.E.
	MIRON PETROVSKY
	GEORGE STEPHENS
	JAY COSTELLO

The 425 foot long dam, built in 1944, is an earthfill embankment with a concrete corewall, concrete spillway and a concrete gatehouse. The earth embankment is 280 feet long and the concrete structures, which include the spillway weir and the intake chamber, are 145 feet in length. The earthfill embankment is 10 feet wide at the top and 30 feet above the streambed of the Muddy River. The spillway is a 90 foot long concrete ogee weir with a concrete apron and a short stone paved discharge channel. Freeboard above the spillway weir crest is 5 feet. The gatehouse, adjacent to the right side of the spillway, is a concrete intake chamber with a screened opening for a 24 inch low level outlet. There are two openings in the upstream chamber wall and one opening in the left wall for three 20 inch supply valves. The outlets are a 20 inch supply line to the downstream filterplant, an 8 inch drain pipe and a 24 inch low level outlet. All gatehouse valves are operable.

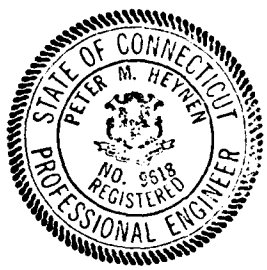
Based upon the visual inspection at the site and past performance of the dam, the dam is judged to be in fair condition. No evidence of instability was observed in the embankment, spillway or appurtenant structures. There are some areas requiring monitoring and maintenance, such as visible seepage at the left side of the embankment toe, seepage through the expansion joints of the spillway weir and the left spillway training wall, and seepage along the left slope of the downstream channel.

In accordance with Corps of Engineers Guidelines and the size (Intermediate) and the hazard (High) classification of the dam, the test flood will be equivalent to the Probable Maximum Flood (PMF). Peak inflow to the reservoir is 15,200 cfs; peak outflow is 14,200 cfs with the dam overtopped 2.9 feet. The spillway capacity is 4,300 cubic feet per second (cfs), which is equivalent to 30% of the routed test flood outflow.

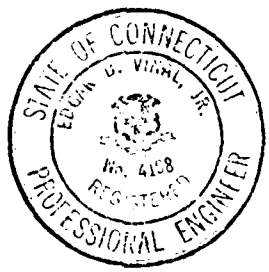
It is recommended that the owner retain the services of a registered professional engineer to perform a more detailed hydraulic/hydrologic analysis to determine the adequacy of the project discharge. Recommendations should be made by the engineer and implemented by the owner.

Further studies should be conducted for immediate identification of the origin and effect of considerable seepage at the toe of the left embankment and downstream area, and also to restore damaged riprap on the upstream slope of the embankment and restore concrete at the spillway and gate house.

The above recommendations and any further remedial measures which are discussed in Section 7, should be instituted within one year of the owner's receipt of this report.



Peter M. Heynen, P.E.
Project Manager
Cahn Engineers, Inc.



Edgar B. Vinal, Jr. P.E.
Senior Vice President
Cahn Engineers, Inc.

This Phase I Inspection Report on Mac Kenzie Reservoir Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam would necessarily represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as neccessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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US ARMY ENGINEER DIV NEW ENGLAND NEDEP-ENGINEERING WALTHAM, MASS	NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS	[illegible]	[illegible]
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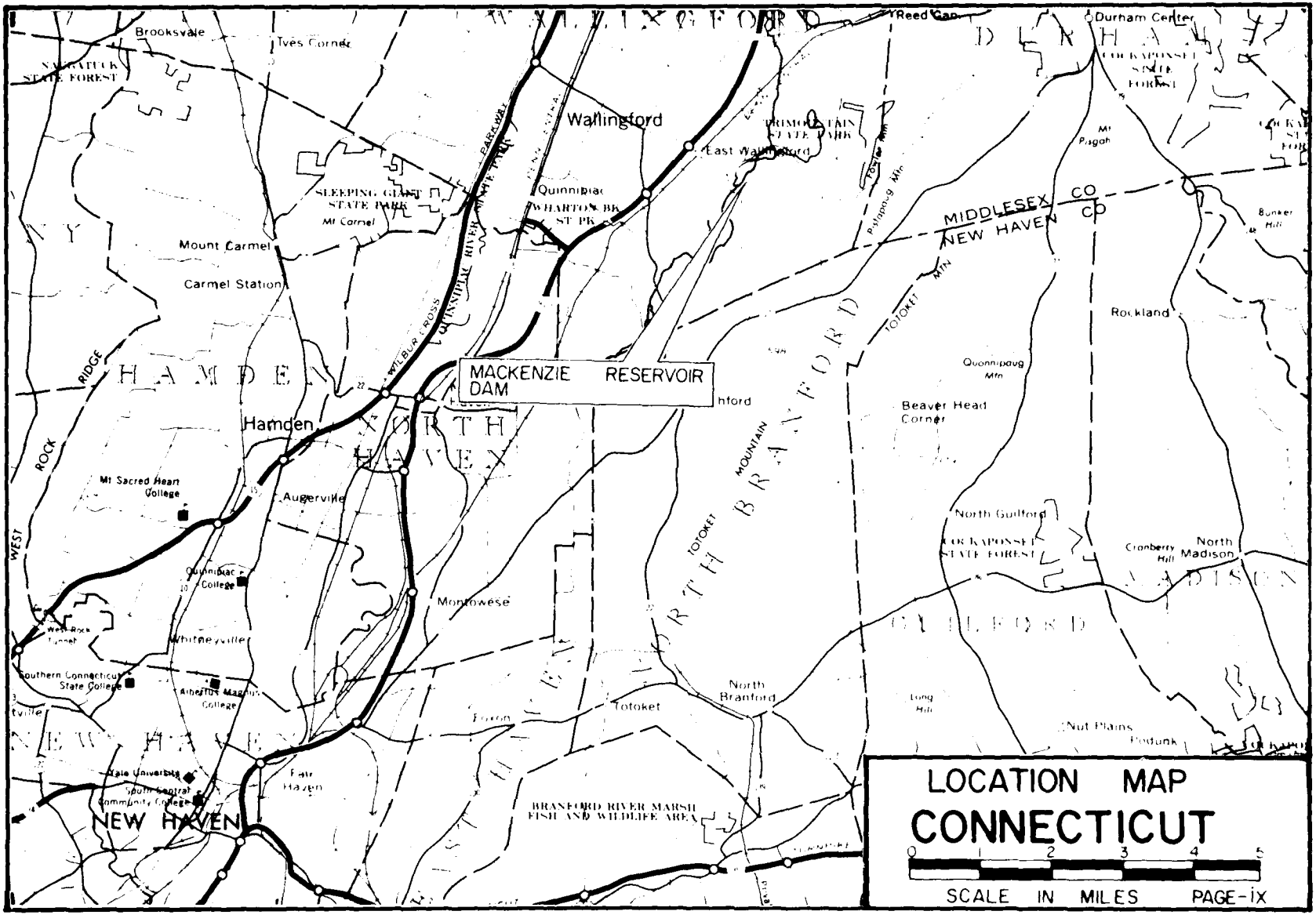

MACKENZIE DAM
RESERVOIR
Wallingford
East Wallingford
Durham Center
Reed Cap
Brooksvale
Tyes Corner
Mount Carmel
Carmel Station
Hamden
Augerville
Mt Sacred Heart College
Quinnipiac College
Montowese
Whitneyville
Southern Connecticut State College
Albertus Magnus College
Yale University
South Central Community College
Fair Haven
NEW HAVEN
Totoket
North Branford
Foxon
North Guilford
North Madison
Rockland
Beaver Head Corner
Quonnipaug Mtn
Totoket Mtn
Mt Pisgah
Bunker Hill
Cranberry Hill
Long Hill
Nut Plains
Podunk
Sleeping Giant State Park
Mt Carmel
Wharton Brook St Pk
Quinnipiac River State Park
Wilbur Ross Parkway
Rock Ridge
West Rock Tunnel
Branford River Marsh Fish and Wildlife Area
Middlesex Co
New Haven Co
LOCATION MAP
CONNECTICUT
0 1 2 3 4 5
SCALE IN MILES

PHASE I INSPECTION REPORT

MACKENZIE RESERVOIR DAM

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of March 30, 1979 from John P. Chandler Colonel, Corps of Engineers. Contract No. DACW 33-79-C-0059 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dam.

3. To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

1. Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

2. A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

3. Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

4. An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgement on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 DESCRIPTION OF PROJECT

a. Location - The dam is located on the Muddy River in a rural area of the town of Wallingford, County of New Haven, State of Connecticut. The dam is shown on the Wallingford USGS Quadrangle Map having coordinates latitude N 41° 26.2" and longitude W 72° 46.7".

b. Description of Dam and Appurtenances - The 425 foot long dam is an earthfill embankment with a concrete corewall, concrete spillway and gatehouse. A sand foundation is the base for the dam and most of the concrete corewall. Wood piles 35 feet in length are used to support the concrete spillway and gatehouse structure, and the corewall near this structure. Steel sheet piling under the corewall and concrete structures, runs along the dam to a depth of 15 to 30 feet into the sand foundation. Steel sheet piling, extending to a depth of 15 feet, is located under the downstream end of the spillway and concrete apron and 30 foot sheet piling is located at the upstream end.

The main embankment and left embankment are approximately 290 feet in total length and 10 feet wide at the top, which is 30 feet above the streambed of the Muddy River. The crest of the dam has elevations 199.0 and 199.5, which are the upstream and downstream edges, respectively. The upstream slope is inclined at 2.5 horizontal to 1 vertical and has slope protection to elevation 198.5 of 10 inch thick riprap underlain by 6 inches of crushed stone. The downstream slope has an inclination of 2 horizontal to 1 vertical and has a seeded grass cover on 8 inches of loam. The top of the concrete corewall is 18 inches wide and 1 foot below the dam crest and the base is 6 foot wide, extending 6 feet or more into the foundation.

The spillway consists of a 90 foot long ogee shaped concrete weir, an 18 foot long concrete apron with concrete training walls and a 27 foot long stone paved channel with a concrete cutoff wall below the downstream edge, where it joins the original streambed of the Muddy River.

A small concrete weir, probably constructed as a stilling basin, is situated across the downstream channel approximately 300 feet from the dam. This small weir is

approximately 50± feet long, 1± foot wide, and 3± feet high, and has steel sheet piling on the upstream face. A notch, approximately 3 feet long and 1 foot deep, is located at the center of the weir and an 18 inch pipe is used as an outlet on the right end.

The gatehouse, forming the right upstream spillway wall, has a concrete intake structure at the base of the wall with a 5 foot long and 3 foot wide screened opening for the 24 inch low-level outlet. There are also 2 openings in the upstream chamber wall and 1 opening in the left chamber wall for 20 inch supply intake valves, which are at centerline elevations 189.0, 183.0, and 176.0, respectively. The outlets are a 20 inch cast iron supply line to the downstream filter plant, an 8 inch cast iron drain pipe and a 24 inch cast iron low level outlet. All outlets have valves that can be operated from the gatehouse and are at elevations 171.5, 170.5 and 171.5, respectively. The 20 inch supply line is left open at the gatehouse and operated at the filterplant. The 24 inch low level outlet and 8 inch drain outlet structure is the concrete training wall at the right side of the spillway apron. All outlets are operated and gates cleaned twice a year.

c. *Size Classification* - INTERMEDIATE - The dam impounds 1,100 acre-feet of water with the reservoir level at the top of the dam, which at elevation 199.5 is 30± feet above the (old) streambed. According to the Recommended Guidelines, this dam is classified as Intermediate in size.

d. Hazard Classification - HIGH - If the dam was to be breached, there is potential for loss of life and extensive property damage at the filter plant and a house, both of which are located directly downstream from the dam. There are at least two personnel from the Wallingford Water and Sewer Department in the filter plant during a daily 8 hour shift from 8 A.M. to 4 P.M.

e. Ownership - Town of Wallingford
Water and Sewer Dept.
377 South Cherry Street
Wallingford, Ct. 06492
Mr. Ned Olsen (203) 269-8795

f. Operator - Mr. Donald DiAndi
(203) 269-0013

g. Purpose of Dam - Water supply

h. Design and Construction History - The following information is believed to be accurate based on the plans and correspondence available. The dam was designed by the Clarence M. Blair, Inc. and completed in 1944. The dam was designed for and operated by the Town of Wallingford for the purpose of water supply.

i. Normal Operational Procedures - All valves are operated manually from floor stands located in the gatehouse. All valves and gates are operated and cleaned twice a year. Of the three 20 inch inlet valves, only the middle valve is in continuous operation and it remains open at the gatehouse and flow is regulated at the filter plant. The 24 inch low-level outlet, which has an estimated capacity of 110 cfs, and the 8 inch drain are operated during the biannual checking and cleaning. The reservoir level is normally maintained at elevation 194.

1.3 PERTINENT DATA

a. Drainage Area - 8.92 sq. miles of rolling wooded terrain. The area is sparsely populated with some small tracts of land being developed for agriculture.

b. Discharge at Damsite - Discharge from the reservoir is through a 20 inch cast iron supply main and over the spillway.

1. Outlet Works (conduits):

20" cast iron supply @ invert el. 170.7±	2 mil. gal./day
24" cast iron low level outlet @ invert el. 170.5+	110 cfs
8" cast iron drain @ invert el. 170.2±	N/A

2. Maximum known flood at damsite: Unknown

3. Ungated spillway capacity @ top of dam el. 199.5: 4,300 cfs

4. Ungated spillway capacity @ test flood el. 202.4: 8000 cfs

5. Gated spillway capacity @ normal pool el.: N/A

6. Gated spillway capacity @ test flood elevation: N/A

7.	Total spillway capacity @ test flood el. 202.4:	8000 cfs
8.	Total project discharge @ test flood el. 202.4:	14,200 cfs.

c. Elevations (Feet Above Mean Sea Level)

1.	Streambed at centerline of dam:	170.0
2.	Maximum tailwater:	N/A
3.	Upstream portal invert diversion tunnel:	N/A
4.	Recreation pool:	N/A
5.	Full flood control pool:	N/A
6.	Spillway crest (ungated):	194.0
7.	Design surcharge (original design):	Unknown
8.	Top of dam:	199.5
9.	Test flood surcharge:	202.4

d. Reservoir

1.	Length of maximum pool:	$4000^{\pm}$ ft.
2.	Length of recreation pool:	N/A
3.	Length of flood control pool:	N/A

e. Storage

1.	Recreation pool:	N/A
2.	Flood control pool:	N/A
3.	Spillway crest pool:	770 acre-ft.
4.	Top of dam:	1100 acre-ft.
5.	Test flood pool:	1280 acre-ft.

f. Reservoir Surface

1.	Recreation pool:	N/A

2. Flood control pool:	N/A
3. Spillway crest:	46.8 acres
4. Top of dam:	60 acres
5. Test flood pool:	62 acres
g. Dam	
1. Type:	Earthfill
2. Length:	425± ft.
3. Height:	30± ft.
4. Top width:	10± ft.
5. Side slopes:	2.5 H to 1 V (Upstream) 2 H to 1 V (Downstream)
6. Zoning:	N/A
7. Impervious Core:	Concrete corewall
8. Cutoff:	N/A
9. Grout curtain:	N/A
10. Other:	Steel sheet piling in foundation
h. Diversion and Regulatory Tunnel:	N/A
i. Spillway	
1. Type:	Concrete ogee weir
2. Length of weir:	90 ft.
3. Crest elevation:	194.0
4. Gates:	N/A
5. Upstream channel:	sloping
6. Downstream channel:	12" stone paving
7. General:	N/A

j. Regulating Outlets

1. Invert:	170.5±
2. Size:	24"
3. Description:	Cast iron low-level outlet
4. Control Mechanism:	Floor stand operated valve at inlet chamber
5. Other:	20" cast iron supply line 8" cast iron drain pipe

SECTION 2: ENGINEERING DATA

2.1 DESIGN

a. Available Data - The available data consists of correspondence by the Wallingford Water Department, inspection reports and recommendations from the State of Connecticut Water Resources Commission, and also a set of four drawings by the designers, Clarence M. Blair, Inc.

b. Design Features - The as-built drawings dated 1944 and correspondence indicate the design features stated previously herein.

c. Design Data - There were no engineering values, assumptions, test results or calculations available for the original construction.

2.2 CONSTRUCTION

a. Available Data - "As-built" drawings and data was available and listed in Appendix B.

b. Construction Considerations - The dam was built according to plans except for minor changes as referred to in Appendix B.

2.3 OPERATIONS

Lake level readings are taken daily and according to the operator, the dam spillway capacity has never been exceeded. Flow into the filter plant is monitored and recorded daily.

2.4 EVALUATION

a. Availability - Existing data was provided by the owner, Clarence M. Blair, Inc. and the State of Connecticut. The owner made the operations available for visual inspection.

b. Adequacy - The detailed engineering data available was generally inadequate to perform an in-depth assessment of the dam, therefore, the final assessment of this dam must be based primarily on visual inspection, performance history, hydraulic computations of spillway capacity and approximate hydrologic judgements.

c. Validity - A comparison of record data and visual observations reveals no observable significant discrepancies in the record data.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General - The general condition of the dam is fair. Inspection did reveal some areas requiring maintenance, monitoring and attention. The reservoir level was at elevation 194.1± (May, 1979) and 193.5± (August, 1979), with water flowing over the spillway only during the May, 1979 inspection.

b. Dam - The dam is an earthfill embankment with a concrete spillway and a concrete gatehouse at the central part of the embankment. No sloughing or erosion of the embankment was noted.

Crest - The 10 foot wide crest is grass covered (Photo 1). The crest is generally uniform except for two depressions at either end of the main embankment. One is located adjacent to the gatehouse slab and is approximately 10 feet long and 6 inches deep. Some undermining of the gatehouse slab in this area was also noted. The other depression is at the right abutment and is 10 feet long and 6 inches deep. The soil was evidently pushed to the left, leaving a small mound, so as to allow easier access to other parts of the reservoir by maintenance vehicles (Photo 2).

Upstream Slope - The upstream slope has hand placed riprap about 2 feet below the crest with a maximum size of approximately 18 inches. Riprap was missing in several places, exposing areas approximately 3 ft. by 4 ft. in size. Grass and weeds were observed between the riprap (Photo 1).

Downstream Slope - The slope inclination is 2 horizontal to 1 vertical. Its protection is an 8 inch thick loam and grass cover. The slope and toe of the main embankment are cut periodically and are in good condition except for small trees located just below the gatehouse (Photo 3). No misalignment, cracks or seepage on the slope were observed.

Trees with a maximum diameter of 12± inches and heavy brush were noted on the slope of the left embankment (Photo 4). Seepage was discovered on the lower portion of the slope and toe adjacent to the left spillway training wall (Photo 5). The seepage and wet area extends along this wall approximately 60 feet with a width of up to 10 feet. A visual assessment of the rate of seepage discharge is 5 to 8 gallons per minute (gpm). In an upper zone of this area, at a distance of 2± feet downstream from the toe of the weir training wall and 1± foot from the inside edge of the spillway channel retaining wall, a seep was discovered with a measured flow rate of 4 gpm (Photo 6). Water emanating from this area was clear, however the

area around the seepage was covered with clayey silt deposits of a bright red and brown color (Photo 5 and 6). The origin of the seepage seems to be through the body of the left embankment in an area adjacent to the concrete spillway wall. The operator noted that there is significant icing in this area during winter months.

Spillway - The spillway is a concrete uncontrolled ogee weir, a concrete apron with concrete training walls and a stone paved channel.

Several seepage spots were observed on the spillway weir and training walls. A seep located at the expansion joint approximately 12± feet below the spillway crest between the weir and the right spillway training wall had a measured flow rate of 2± gallons per minute (Photo 7). Another seep was noted approximately 14± feet below the spillway crest at the vertical construction joint 30 feet from the left spillway training wall and had an estimated flow rate of 1 to 2 gpm. The concrete at this joint was showing signs of deterioration and was cracked to a depth of 1 to 2 inches. Wet areas below several of the horizontal construction joints were noted about 12 feet below the spillway crest. (Photo 3)

Several seepage spots were observed on the vertical expansion joints at the downstream channel left training wall. There was spalling of the concrete walls on both sides of the channel, exposing the aggregate in several areas. Several cracks with lime deposits were also noted on the channel walls.

c. Appurtenant Structures - The concrete gatehouse structure is generally in good condition. There are cracks in the downstream wall with white lime efflorenscence (Photo 8) and deterioration of the concrete surface on the top of the structure near the gatehouse.

d. Reservoir Area - The area surrounding the reservoir is wooded and largely undeveloped. The slopes near the dam are stable and do not have any visible evidence of erosion or sloughing.

e. Downstream Channel - The downstream channel runs in the natural bed of the old Muddy River. A small sheet pile and concrete weir exists in the downstream riverbed about 300 feet from the dam. The inspection revealed several seepage areas on the left slope of the channel along a distance of approximately 80 feet downstream from the toe of the spillway training wall. By visual observation, the flow rates were estimated to be from 0.1 to 10 gpm. No evidence that fine materials were being transported through the left embankment was found. The source of the seepage area was not clear, but its existence could indicate seepage through the foundation of the embankment. At the time of the August 9, 1979 inspection, there was no flow over the spillway weir, however the 18 inch pipe at the small weir was flowing one-third full.

3.2 Evaluation

Based upon the visual inspection, the dam is assessed as being generally in fair condition. The following features which could influence the future condition and/or stability of the dam were identified.

1. Missing riprap has exposed some areas on the upstream slope of the embankment and could lead to erosion of the slope and decrease the stability of the dam.

2. Seepage through the left embankment can potentially increase in flow, leading to erosion and sloughing of the downstream slope and instability of the concrete training wall at the spillway.

3. Cracks and surface deterioration of the concrete in the spillway, spillway training walls and gatehouse chamber could lead to more extensive concrete damages and a decrease in stability of the concrete structures.

4. Heavy vegetation (grass, bushes, trees) on the downstream slope of the left embankment could result in additional seepage along the tree roots.

5. Seepage through the construction joints of the spillway weir and left training wall could lead to saturation of the concrete with accelerating and extensive damage by freeze-thaw cycles.

6. Undermining of the gatehouse slab and low spots in this area and at the right abutment could lead to overtopping and erosion of the embankment.

7. Flow through the 18 inch pipe in the stilling basin weir with no flow over the dam spillway could be an indication of seepage through the embankment.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Regulating Procedures

The low-level outlet is operated for maintenance and flow is regulated from the filter plant through the supply main.

4.2 Maintenance of Dam

The owner cuts the grass and removes the brush periodically except during the winter season. There is no formal inspection of the dam except for visual checks by the Water and Sewer Department.

4.3 Maintenance of Operating Procedures

All valves are operated and gates cleaned twice a year. The top two valves were replaced several years ago.

4.4 Description of any Formal Warning System in Effect

No formal warning system is in effect.

4.5 Evaluation

The operation and maintenance procedures are generally fair, however, there are some areas requiring improvement. A formal program of operation and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a formal warning system should be developed and implemented within the time frame indicated in Section 7.1c. Remedial operation and maintenance recommendations are presented in Section 7.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General - The dam is basically a low surcharge storage -high spillage earth embankment used for water supply. There is a road embankment across the reservoir at Whirlwind Hill Road with an 8 foot by 8 foot culvert, which controls flow from the upper to the lower part of the reservoir. The inverts of the culvert are at 180± MSL and the surface elevation of the road is at 200± MSL. There is also a 60 inch concrete pipe under Scard Road along the western side of the reservoir. This pipe controls only a small part of the reservoir drainage area and will not be considered in the test flood analysis.

b. Design Data - No computations could be found for the original dam construction.

c. Experience Data - No information on serious problem situations arising at the dam were found, and it does not appear the dam has been overtopped.

d. Visual Observations - No overhanging trees or visible obstructions were noted in the spillway channel or outlets. A small concrete dam is located in the spillway discharge channel approximately 300 feet downstream from the spillway weir. This dam measured 50 feet in length, 3 feet in height and 1 foot in width. There is a 3+ foot by 1± foot rectangular weir at the center of the dam and an 18 inch pipe used as a low level outlet at the right end.

e. Test Flood Analysis - The test flood for this high hazard, intermediate size dam is equivalent to the Probable Maximum Flood (PMF). Based upon "Preliminary Guidance for Estimating Maximum Probable Discharge", dated March, 1978, peak inflow to the reservoir is 15,200 cfs (Appendix "D-1"); peak outflow is 14,200 cfs with the dam overtopped 2.9 feet (Appendix "D-5"). Based upon our hydraulics computations, the spillway capacity is 4300 cfs, which is approximately 30% of the routed Test Flood outflow. Of the total drainage area of 8.9 square miles, 8.7 square miles are upstream from the Whirlwind Hill Road crossing. Because this crossing controls almost all of the inflow to the reservoir and the structural ability of the embankment to withstand a differential head is unknown, the test flood will be analyzed disregarding the effect of the Whirlwind Hill Road crossing.

f. Dam Failure Analysis - Utilizing the April, 1978, "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", the peak failure outflow from the dam breaching would be 17,000 cubic feet per second. A breach of the dam would result in a rise of 6.6 feet in the water level of the stream at the initial impact area, which corresponds to an increase in the water level from a depth of 10.4 feet just before the breach, to a depth of 17.0 feet just after the breach. The rapid 6.6 foot increase in the water level at the initial impact area would inundate the house and filter plant directly below the dam to a depth of 3-5 feet.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations - The visual inspection did not reveal any indications of stability problems. There are some areas of seepage and concrete deterioration, as described in Section 3, however they are not considered stability concerns at the present time.

b. Design and Construction Data - The drawings and data available and listed in Appendix B was not sufficient to perform an in-depth stability analysis of the dam. Although "as-built" drawings were available, no engineering assumptions, data or calculations could be found for the original design of the dam.

c. Operating Records - The operating records do not include any indications of dam instability since its construction in 1944.

d. Post Construction Changes - There are no records available concerning any post-construction changes of dam.

e. Seismic Stability - The dam is in Seismic Zone 1 and according to the Recommended Guidelines, need not to be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - Based upon the visual inspection of the site and past performance, the dam appears to be in fair condition. No evidence of structural instability was observed. The embankment is generally in fair condition with areas of some concern, such as maintenance and monitoring problems.

Based upon "Preliminary Guidance for Estimating Maximum Probable Discharge" dated March, 1978, peak inflow to the reservoir is 15,200 cubic feet per second; peak outflow is 14,200 cubic feet per second with the dam overtopped 2.9 feet. Based upon our hydraulics computations, the spillway capacity is 4,300 cubic feet per second, which is equivalent to approximately 30% of the routed Test Flood outflow.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the dam must be based solely on visual inspection, past performance of the dam, and sound engineering judgement.

c. Urgency - It is recommended that the measures presented in Section 7.2 and 7.3 be implemented within one year of the owner's receipt of this report.

d. Need for Additional Information - There is a need for more information as recommended in Section 7.2.

7.2 Recommendations

a. It is recommended that further studies by made by a registered professional engineer qualified in dam design and inspection pertaining to the following:

1. A detailed hydraulic/hydrologic analysis should be performed to determine the adequacy of the project discharge. Recommendations should be made by the engineer and implemented by the owner.

2. Inspection of the dam during times of low head, as well as high head, to check observable seepage and the condition of the spillway. An evaluation of the significance of the seepage, as well as the condition of the spillway should be undertaken, and any necessary recommendations made. Items of particular importance would be seepage spots at the toe of the left embankment, spillway weir and training wall construction joints, and at the left slope of the spillway discharge channel.

3. Removal of the trees on the downstream slope and toe of the left embankment.

4. Discharge through the 18 inch pipe in the small dam downstream should be monitored when there is no flow over the spillway weir so as to get a better understanding of the amount of total seepage in the dam vicinity.

7.3 Remedial Measures

a. Operation and Maintenance Procedures - The following measures should be undertaken within the time frame indicated in Section 7.1.c, and continued on a regular basis.

1. Round-the-clock surveillance should be provided by the owner during periods of unusually heavy precipitation and high project discharge. The owner should develop a downstream warning systemin case of emergencies at the dam.

2. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference.

3. A program of inspection by a registered, professional engineer qualified in dam inspection should be instituted on an annual basis. The inspections should be comprehensive in nature and should include the operation of the low level outlet works.

4. Concrete surface deterioration and cracks in concrete of the spillway weir, spillway training walls and gatehouse should be repaired.

5. Small trees and brush on the downstream slope and the toe of the embankment and any vegetation on the riprap at the upstream slope of the embankment should be removed. The cutting of grass on the downstream slope and crest of the dam should be continued as part of the routine dam maintenance.

6. Exposed areas on the upstream slope of the embankment should be riprapped.

7. Construction joints at the spillway weir and training walls should be sealed to eliminate further seepage. Also, seepage at the left embankment toe and downstream channel should be monitored periodically.

8. The undermining of the gatehouse slab on the dam crest and low spots in this area and at the right abutment should be filled in, compacted and reseeded.

7.4 Alternatives

This study has identified no practical alternatives to the above recommendations.

APPENDIX A
INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT MacKenzie Reservoir Dam DATE: May 6, 1978

TIME: 4:30 p.m

WEATHER: Sunny, 75°F

W.S. ELEV. 74.1 U.S. ____ DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. Peter M. Heynen	PMH	Cahn Engineers, Inc.
2. Miron Petrovsky	MP	Cahn Engineers, Inc.
3. George Stephens	GS	Cahn Engineers, Inc.
4. Jay Costello	JC	Cahn Engineers, Inc.
5. Donald Di Andi	(Owner Representative)	Town of Wallingford
6.		Water and Sewer Dept.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Earthfill Embankment	PMH, MP, JC	
2.	Concrete Spillway & Channel	PMH, GS, MP, JC	
3.	Gatehouse	PMH, GS, MP	
4.	Outlet Structure	PMH, MP, JC	
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT Mackenzie Reservoir Dam DATE May 2, 1979

PROJECT FEATURE Earthfill Embankment BY PMH, MP

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	199.5
Current Pool Elevation	194.1±
Maximum Impoundment to Date	N/A
Surface Cracks	None observed
Pavement Condition	N/A
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	appears good
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection-Riprap Failures	some riprap loss on u/s slope
Unusual Movement or Cracking at or Near Toes	None observed
Unusual Embankment or Downstream Seepage	considerable seepage on D/s slope and toe of left embankment
Piping or Boils	
Foundation Drainage Features	N/A
Toe Drains	
Instrumentation System	

PERIODIC INSPECTION CHECK LIST

PROJECT Mackenzie Reservoir Dam DATE May 2, 1979

PROJECT FEATURE Concrete Gate House BY PMH, MP, GS, JC

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a) Concrete and Structural	Brick structure & concrete chamber
General Condition	Good
Condition of Joints	Not observed
Spalling	Some noted on chamber top
Visible Reinforcing	Not observed
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	Some lime deposits
Joint Alignment	Not observed
Unusual Seepage or Leaks in Gate Chamber	Not observed
Cracks	Several cracks on d/s face of chamber
Rusting or Corrosion of Steel	None observed
b) Mechanical and Electrical	
Air Vents	N/A
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	6 manual valves, all operable
Emergency Gates	N/A
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECK LIST

Page

PROJECT Mackenzie Reservoir Dam DATE May 2, 1974

PROJECT FEATURE Outlet Structure BY PMH, MPJC

AREA EVALUATED	CONDITION
OUTLET WORKS-OUTLET STRUCTURE AND OUTLET CHANNEL	24" slowoff and 8" drain pipe in spillway concrete right retain. wall
General Condition of Concrete	good
Rust or Staining	None observed
Spalling	several cracks
Erosion or Cavitation	
Visible Reinforcing	None observed
Any Seepage or Efflorescence	
Condition at Joints	N/A
Drain Holes	
Channel	
Loose Rock or Trees Overhanging Channel	appears good
Condition of Discharge Channel	good

PERIODIC INSPECTION CHECK LIST

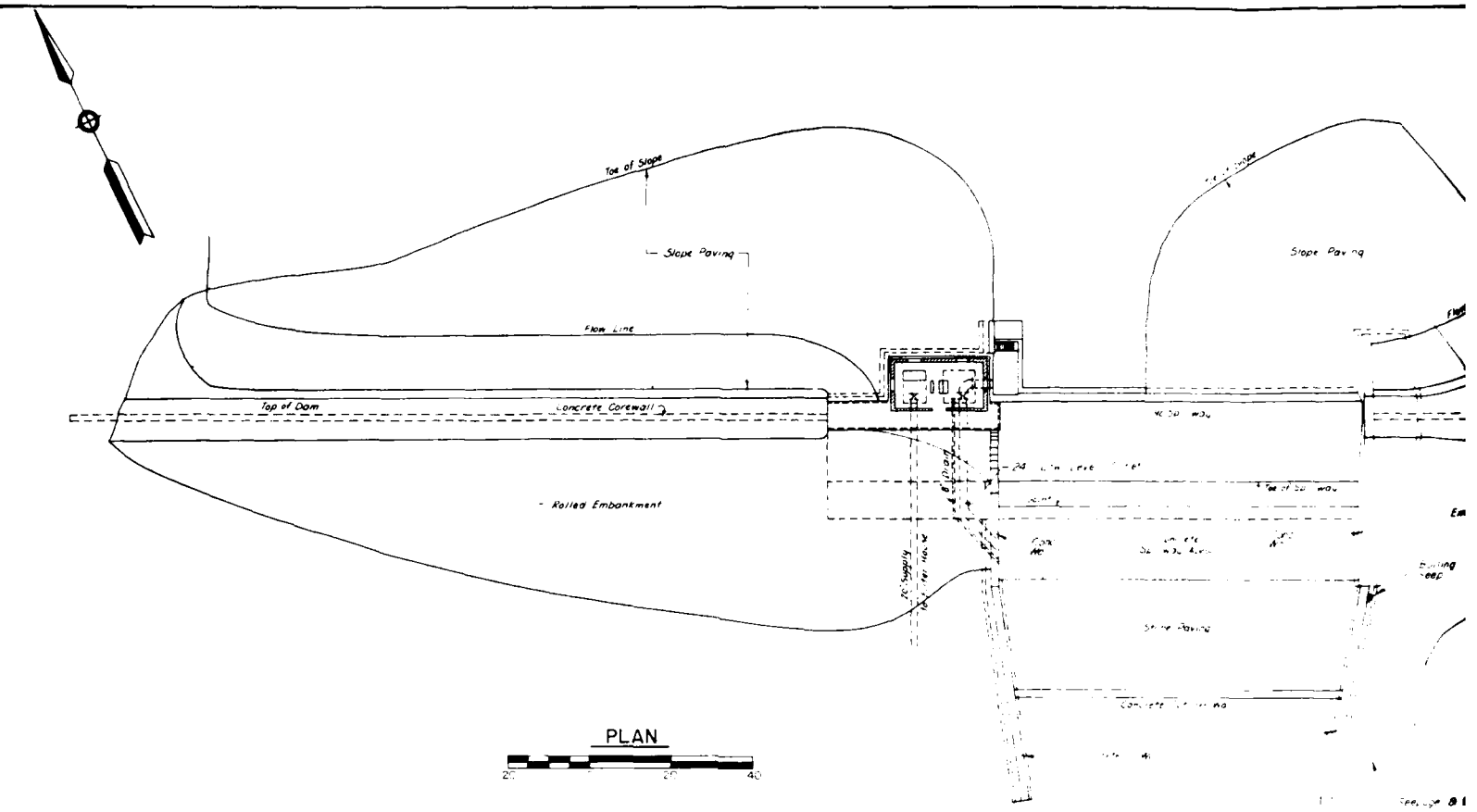
PROJECT MacKenzie Reservoir Dam DATE May 2, 1979

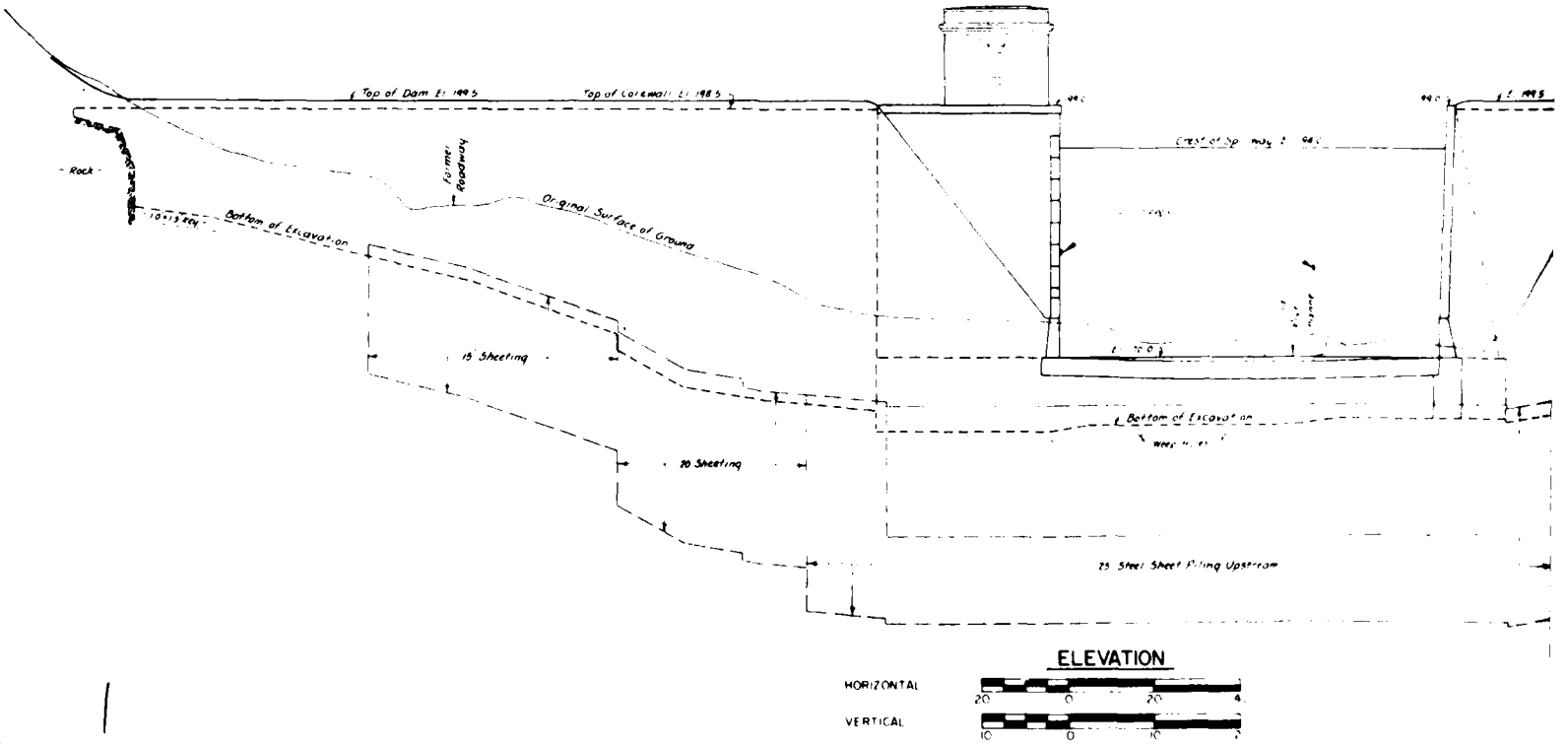
PROJECT FEATURE Concrete Spillway & Channel BY PMH, MP, GS, JC

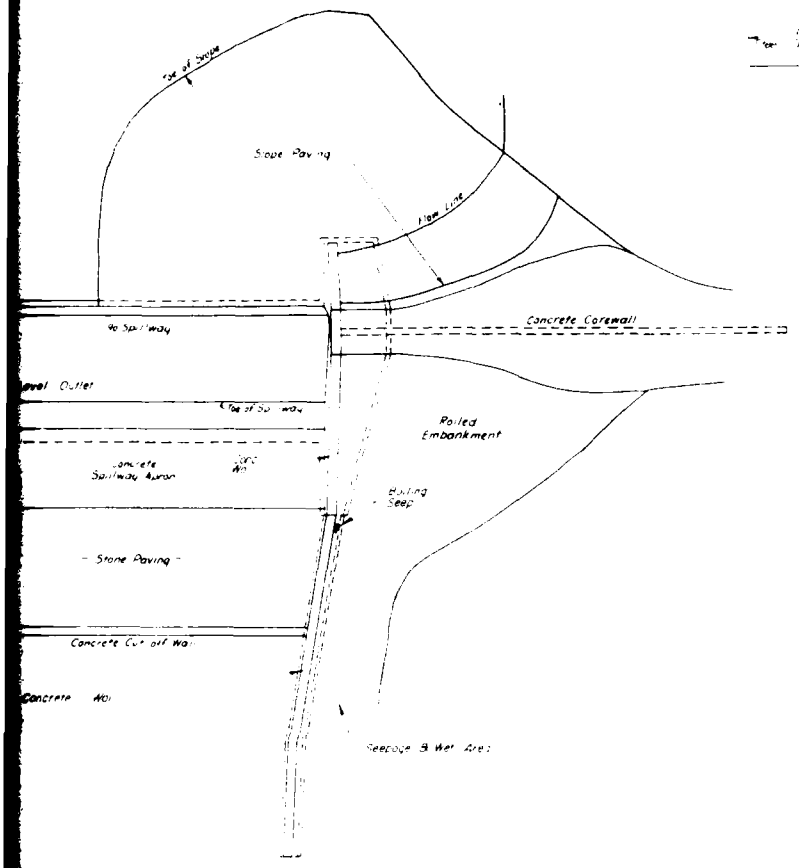
AREA EVALUATED		CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS		
a) Approach Channel		
General Condition		Good
Loose Rock Overhanging Channel		N/A
Trees Overhanging Channel		N/A
Floor of Approach Channel		Under water
b) Weir and Training Walls		
General Condition of Concrete		Good
Rust or Staining		None observed
Spalling		spalling noted on weir
Any Visible Reinforcing		None observed
Any Seepage or Efflorescence		Some lime deposits
Drain Holes		Unknown
c) Discharge Channel		
General Condition		Appears good
Loose Rock Overhanging Channel		None observed
Trees Overhanging Channel		Some on left slope
Floor of Channel		Stone paving
Other Obstructions		small jam 300' d/s from weir

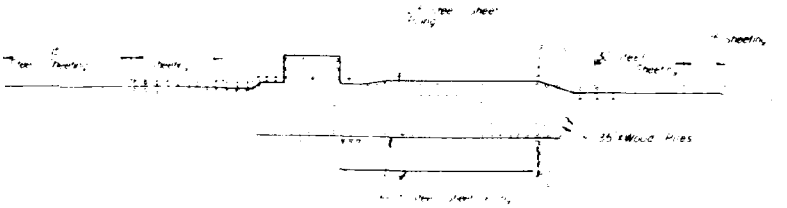
APPENDIX B

ENGINEERING DATA AND CORRESPONDENCE

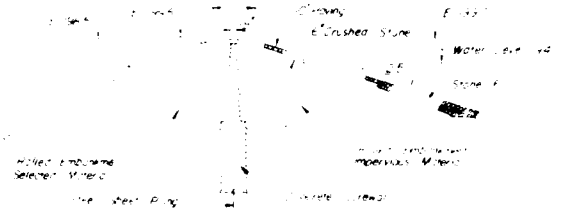

Toe of Slope
Slope Paving
Flow Line
Top of Dam
Concrete Corewall
Rolled Embankment
Slope Paving
PLAN
20
0
20
40


℄ Top of Dam El. 199.5
Top of Corewall El. 198.5
Rock
Former Roadway
Original Surface of Ground
Bottom of Excavation
15 Sheeting
20 Sheeting
℄ Bottom of Excavation
25 Steel Sheet Piling Upstream
ELEVATION
HORIZONTAL
VERTICAL
20
0
20
40
10
0
10

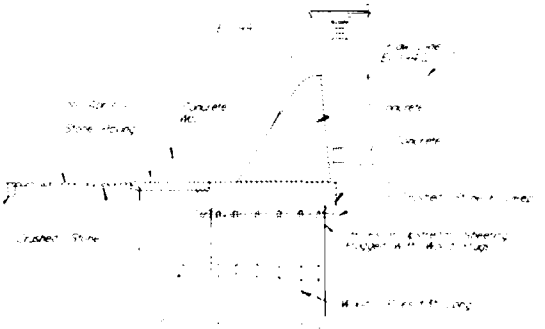




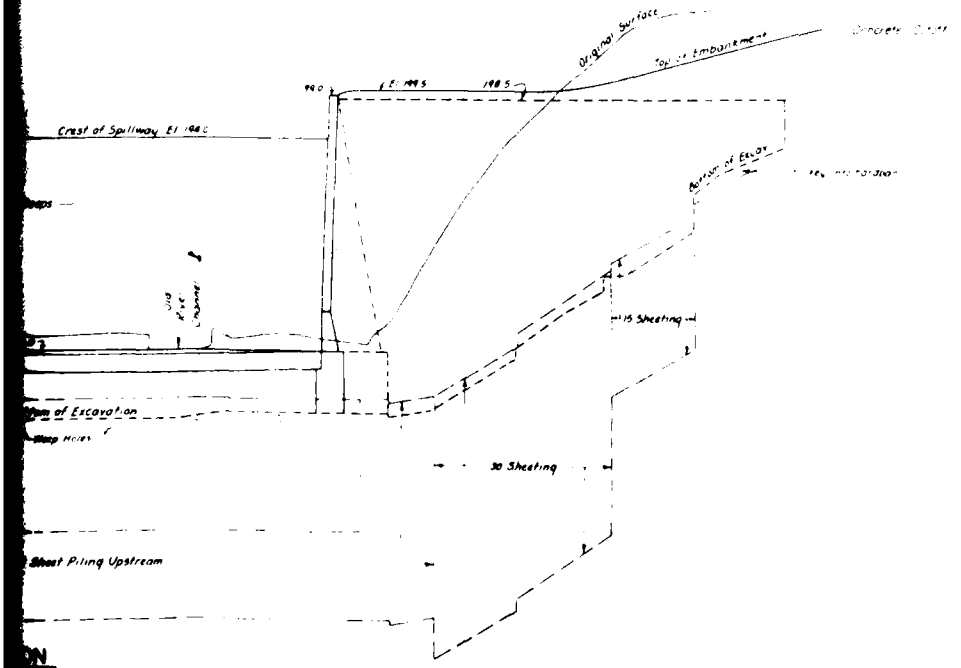
FOUNDATION PLAN SHOWING
STEEL SHEET PILING AND WOOD PILES



SECTION THRU EMBANKMENT



SECTION THRU SPILLWAY



NOTES

JAHN ENGINEERS, INC. ENGINEER		U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.		
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS PLAN ELEVATION AND SECTIONS MACKENZIE RESERVOIR DAM MUDDY RIVER WALLINGFORD, CONNECTICUT				
DRAWN BY	CHECKED BY	APPROVED BY	SCALE AS NOTED	
		DMH	DATE JULY 1979	SHEET 8

MACKENZIE RESERVOIR DAM

EXISTING PLANS

Water Department - Borough of Wallingford
"Plan of Dam" (1942)
Pine River - Wallingford, Conn.
Clarence M. Blair Associates, Inc.
New Haven, Conn.
3 sheets

Water Department - Borough of Wallingford
"Plan of Dam" (1944)
Pine River - Wallingford, Conn.
Clarence M. Blair Associates, Inc.
New Haven, Conn.
1 sheet

SUMMARY OF DATA AND CORRESPONDENCE

DISTANCE BELOW TOP OF DAM	ELEV.	OFFSET BASE LINE TO FACE	OFFSET BASE LINE TO BACK
0	199	0'4"	6'4"
1	198	0'4"	6'4
		0'1 1/4	6'0
2	197	0'2 3/8	6'0 1/4
3	196	0'3 5/8"	6'0 7/8
4	195	0'4 3/4"	6'1 7/8"
5	194	0'6"	6'3 1/2
6	193	0'7 1/4	6'5 3/8
7	192	0'8 3/8	6'7 7/8
8	191	0'9 5/8"	6'10 3/4
9	190	0'10 3/4	7'2 1/8
10	189	1'0"	7'5
11	188	1'1 1/4	7'10 3/8"
12	187	1'2 3/8	8'3 1/4
13	186	1'3 5/8	8'8 3/4
14	185	1'4 3/4	9'2 3/4"
15	184	1'6	9'9 1/8
16	183	1'7 1/4	10'4 3/8
17	182	1'8 3/	11'0 5/8
18	181	1'9 5/	11'8 3/8
19	180	1'10 3/4	12'4 1/4
20	179	[illegible]	13'0
21	178	[illegible]	13'7 3/8
22	177	[illegible]	14'5 3/8
23	176	[illegible]	15'3 5/8
24	175	[illegible]	16'2 1/8
25	174	[illegible]	17'1
26	173	[illegible]	18'0 3/4
27	172	[illegible]	18'10 5/8
28	171	[illegible]	19'9 3/
29	170	[illegible]	20'8 1/4

U - 11

STATE BOARD FOR THE SUPERVISION OF DAMS
INVENTORY DATA

NAME OF DAM OR POND Pine River R-23 (also called MACKENZIE R23)

CODE NO. ~~(10-32)~~ M9.2 1941

LOCATION OF STRUCTURE:

Town W'FORD

Name of Stream MUDDY R.

U.S.G.S. Quad. W'FORD Long. 72- ' " Lat. 41- -15

OWNER: Wallingford, water Co.

Address _____

Telephone _____

1941

Pond Used For: Public Water Supply

Dimensions of Pond: Width _____ Length _____ Area ~~40 Dy D.1-2~~ 513

Depth of Water below Spillway Level (Downstream) 30'

Total Length of Dam 300 - 400 Length of Spillway 50

Height of Abutments above Spillway 4 -

Type of Soillway Construction Concrete

Type of Dike Construction Earth

Downstream Conditions Road down Stream

Summary of File Data File shows no cer. of app granted for this dam.

Remarks large dam would cause damage should at least check over files as to why approval not granted also check file on Pistapaug —

B-5

NORTH AMERICAN CEMENT CORPORATION

MANUFACTURERS

CEMENT · LIME · STONE PRODUCTS

OFFICES
ALBANY
BALTIMORE
BOSTON
HAGERSTOWN
NEW YORK
WASHINGTON

285 MADISON AVENUE
NEW YORK CITY

PLANTS
CATSKILL, N.Y.
HOWES CAVE, N.Y.
SECRETARY, PA.
MARTINSBURG, W.VA.

November 21, 1941

Mr. Clarence M. Blair
Clarence M. Blair Inc.
100 Crown Street
New Haven, Connecticut

Dear Mr. Blair:

In accordance with our conversation the other day, I am enclosing herewith a copy of A.S.T.M. Specifications C 150 - 40 T, covering the chemical and physical requirements for Type II portland cement. I am also enclosing a copy of Federal Specification SS-C-206a, covering moderate heat of hardening, portland cement. The cement we manufacture at both our Howes Cave and Catskill plants fully meet these requirements by a large margin.

In particular I would like to call to your attention the low C_3A contents of our cements. Our Howes Cave plant cement will average 6.5% and Catskill about 7.0%. The autoclave expansion on both of these cements is very low and will be less than .03%. The specifications, as you will note, permit an expansion as high as 0.50%. The compressive and tensile strengths of both the Howes Cave and Catskill cements are far above the requirements, our 7 day tensile averaging 350#, or better, and the 28 day compressive strengths averaging 4600#, or better. These strengths are Type I cement performance PLUS and will permit you to proceed with your work under wintertime conditions - the same as if Type I were being used. Both these cements fully meet the requirements of the American Association of State Highway Officials for Moderate Sulphate Resisting Cement M-6-38.

We would deem it a pleasure indeed to be able to take you to these plants as I am sure that you will be very much interested in the control methods being used to assure uniform products and at that time I am quite sure our chief chemist, Mr. H. F. Kichline, can give you some very interesting information regarding what constitutes real cement quality.

May I at this time thank you very much for the time you so kindly gave Mr. Leach and myself the other day and if there is any additional information that you desire, please do not hesitate to call on the writer or our chief chemist, Mr. H. F. Kichline, Catskill, N. Y.

Very truly yours,
NORTH AMERICAN CEMENT CORPORATION

Ansel T. Rogers
Manager Technical Service Department

c: Mr. William A. MacKenzie, City Engr.
Allingford, Connecticut.

ATR:AC
ENCLS.

May 21, 1942

Wallingford Water Dept.
Town Hall
Wallingford, Conn.

Attn: Mr. W. A. MacKenzie, Sup't.

Gentlemen:

We have indicated on the enclosed blueprint the breakdown of our estimate on the sheet piling required for the Pine River Dam. Following is a tabulation of the different areas, the locations of which are shown by different colors on the print.

Location	Length of Section	Length of Sheeting	Area (Sq.Ft.)
Corewall	50'±	15'	750
	43'±	20'	860
	20'±	25'	500
Upstream Cut-off	181'±	25'	4,525
	6'±	20'	120
	26'±	15'	390
Downstream "	189'±	15'	2,835
Cut-off at downstream edge of spillway apron	100'±	15'	1,500
		Total Area:	11,480

Listing according to lengths:

Length	Area	
25'	5,025	sq.ft.
20'	980	" "
15'	5,475	" "
	11,480	" "

These areas are for square feet of wall and the lineal feet of piling required will depend upon the particular section used.

Very truly yours,

Clarence M. Blair, Inc.

By

President

June 2,1942

Colonel William N. Carey,Chief Engineer
Federal Works Agency
Washington, D.C.

Dear Colonel Carey:

I have been acting as Consulting Engineer to the Wallingford (Connecticut) Water Department in connection with the proposed addition to its water facilities by the construction of a dam on Pine River, Wallingford, Conn. Mr. W. A. MacKenzie, Superintendent and Engineer for the Wallingford Water Department has had considerable correspondence with your Agency through Senator Francis T. Maloney. The Borough of Wallingford has requested a grant from your Agency for grading and finishing semi-improved roads that must be relocated in connection with the reservoir project.

In a letter from General Fleming, Administrator, to Senator Maloney dated May 22, 1942, your files C-22, approval was withheld for the highway and bridge improvements, Docket No. Conn. 6-187. This letter stated that your office would be pleased to examine additional information to establish a definite defense-connected need for the project.

I have examined the letter referred to and also Mr. MacKenzie's letter dated June 1, 1942, directed to Senator Maloney. I do not wish to burden you with further facts, but I feel that previous investigations may have missed the point of the importance of this project to the defence industries of Wallingford.

The water supply for this town has been taken from Pistapaug Pond, a large reservoir in the easterly section of the town. Due to an unfortunate accident about a year ago, the dam impounding this large reservoir developed a serious leak, and a considerable volume of water was lost before repairs were made. The storage was depleted, and with a particularly dry Summer and consequent low water yield, the Borough of Wallingford was obliged to augment this depleted storage in Pistapaug Pond, by pumping from an intake in Pine River. It was a case of literally "squeezing " this Pine River to provide water day by day for Wallingford use.

It appears from the correspondence referred to that the withholding of approval of this project was based primarily on the fact that the proposed roads would not be used in the activities of the War Department. This is true insofar as troop movements may be concerned.

I would stress, however, the necessity of this project of relocating the roads, so that Wallinford can furnish a safe and adequate supply of potable water for the increasing war production effort of its industries. Being quite familiar with the water shortage of 1941, I am strongly of the opinion that the construction of this added water facility is absolutely necessary to supply the large volumes of water demanded by the industries in their efforts to supply matterials required in this war effort. The consumption of water has increased sharply since 1941, and this Pine River supply is the only available location to increase the supply adequately.

May I add a personal note. I can well imagine how busy you are in Washington, and am sorry to add one more matter to your present load. But I feel so strongly that this project is so vital to the water supply of Wallingford in furthering its defense efforts, that I have taken this opportunity of addressing you.

I am considering plans for our trip to your home state, and Mineapolis for the annual meeting next month, and I hope that things may break so that we may have the pleasure of renewing our acquaintances with Mrs. Carey and yourself.

With kindest regards, I am

Sincerely yours,

CMB:GRB

In Reply Refer To:
C-22
Docket No. Conn. 6-187

Chief Engineer

Chief, Project Control Section

Docket No. Conn. 6-187
Wallingford - Highway Improvements

This is with reference to the application for Federal funds to aid in the relocation of roads and bridges in Wallingford, Connecticut, Docket No. Conn. 6-187.

In accordance with existing procedure, the subject application was referred to the Public Roads Administration on February 25 for consideration and recommendation. On March 2 that Administration advised that, in the opinion of the War Department, the project was not of sufficient import to National Defense to warrant consideration. On March 12 this office advised the War Department of the need for the proposed facilities and requested that its previous decision be reviewed. A reply was received on May 5 advising that the matter had again been investigated and, while it appears that there is an implied moral obligation for Federal assistance, it is believed that the roads to be inundated are not of primary import. The War Department stated further that, in view of the urgent necessity for conserving material, equipment and man-power, it was not believed advisable that the project be undertaken at this time unless additional evidence were presented by the industries concerned to the effect that the roads are essential to their functioning in the war production program.

Regional Engineer James A. McConnell was advised of this decision in a memorandum dated May 16, and his comments were requested relative to the urgency of the project. Mr. McConnell replied on May 22 that the docket was to be presented to the Area Board in Boston.

In view of the adverse recommendation by the War Department, no funds can be allotted for the project on the basis of information

now at hand and, consequently, further action on the application has been suspended. However, should the Area Board in Boston look with favor on the construction of these facilities, the case will be reopened for further consideration.

P. F. Seward
Chief, Project Control
Section

WALLINGFORD BOARD OF WATER COMMISSIONERS

OFFICE TOWN HALL BUILDING
WALLINGFORD, CONNECTICUT

July 8, 1942

Mr. C. M. Blair
Brown Street
New Haven, Conn.

Dear Mr. Blair:

Please be advised that this morning, July 8, I established an approximate grade of the proposed highway to the west of the hill through the Smith, Leete property. Please figure the quantities both cut and fill.

Mr. Brown no doubt has a very good idea as to how much of the hill would turn out to be rock and how much to be earth. This fill should be figured for a 35' width at the road surface or top of the fill such as to allow sufficient width for installing railing on both sides of the fill. The slopes on the fill should be one on two, as I believe that of the hill would be slightly greater than that of the fill. If Mr. Brown finds that the cut is greater than the fill, we can no doubt revise the grade slightly so as to use up all of the cut from the side hill. We should also provide for surfacing on the fill of at least in depth for the local gravel surfacing obtained for the new road.

Mr. Brown, some three weeks ago, made some figures on all gates at pumping station to determine and figure the length of the operating rods for the gates in the gatehouse. I trust that he will complete that and give me his figures at the very earliest moment so I can order them from The Chapman Valve Company. I desire to use 1 3/4" steel rods and all the gates are equipped with a bronze coupling with a screw in the end of same such that the steel rod will screw into the coupling and be pinned to same with either steel or bronze pin. These 1 3/4" steel rods will extend through a 8" wrought iron pipe nipple that is installed in the concrete floor of the gatehouse, and the upper end of the rod will be left with a tapering square head such that the operating keys can fit on same to operate the gates. As you know, it's practically impossible to buy the bronze rods today and I am also leaving out the operating stands, as I am discouraged in getting any more material than I am absolutely need in completing the job.

Please make the following note and tell Mr. Brown that it is 1" from the center of the 8" gate to the top of the coupling that is now attached to this 8" gate.

Very truly yours,

Wallingford Water Department

William A. Mackenzie
Superintendent

wam/jh

B-1

WALLINGFORD BOARD OF WATER COMMISSIONERS
PINE RIVER DAM

LIST OF EXTENSION STEMS FOR GATE VALVES IN GATE HOUSE WELLS

JULY 14,1942

Valve	Size	Elev. of CL of Valve	Elev. of Floor	Length of Extension Stem
Blowoff	24"	171.50	200.50	27'-0
Supply	20"	171.50	200.50	28'-0
Intake	20"	176.00	200.50	24'-0
Intake	20"	183.00	200.50	17'-0
Intake	20"	190.00	200.50	10'-0
Drain	8"	170.75	200.50	30'-5

Note: Lengths of extension stems listed are figured from the top of coupling on the gear to a point 3'-0" above the floor of the gate house

Note: Superceded, see list of Sept 28,1942

July 10,1942

Mr. W.A. MacKenzie, Sup't
Water Dept.
Town Hall
Wallingford, Conn.

Dear Mr. MacKenzie:

Please be advised that we have figured a preliminary estimate of cuts and fills on the proposed road west of the dam through the Smith Leete property. The line we used is labeled "Center Line" on a location sketch, and the finished grade is shown on the profile sent to you under separate cover. Typical cross sections of cut and fill are also shown on the profile. It was assumed that the cut between Sta.8+60 and 10+60 was all rock except for an average overburden of 2' in depth.

Our estimate is:

Rock cut	2,700	cu.yds.
Earth cut	1,695	
Fill	4,490	
8" gravel roadway	750	"

We have made an estimate of the yardage of concrete required in lowering the top of the dam from Elev. 208.5 to 200.5. This estimate is based on the profile of the dam as shown on the plans, and amounts to 350 cu.yds. of concrete.

We are enclosing a list of lengths of extension stems for the gate valves. A print of the plan of the gate house is also sent to you under separate cover.

It might be desirable to send the letter to Chapman Valve Mfg. Co. when you order the stems.

Very truly yours,

Clarence M. Blair, Inc.

By

rcb/arb

July 24, 1942

Board of Water Commissioners
Borough of Wallingford
Mr. William MacKenzie, Engineer

Dear Mr MacKenzie:

I have been giving considerable thought since my inspection trip of yesterday at the site of your proposed dam on Pine River of the character of the soil that the concrete footings would bear upon.

As I stated to you and others at our conference yesterday I have never had anything to do with a dam built on material or soil conditions such as you have. Mr. Brown, Engineer from the office of C. M. Blair, stated that the soil pressure would be about two ton per square feet. The bearing capacity of this soil might be good for this load provided it were absolutly confined on all sides, however, I anticipate there would be trouble in placing the concrete and with one area loaded up with concrete I would expect that the soil might boil out from underneath the concrete.

I therefore believe and would recommend that in order to be absolutely sure as to the safety of this dam that pilings be installed. I would also suggest that you have Mr. Blair's office submit a design for the same.

Meanwhile I see no reason why we can not proceed with the installing of the steel pilings as shown on the plans.

I'll appreciate hearing from you as to your reaction to the above recommendations and suggestions.

Very truly yours,

W. D. Clarke

JC/WDC

Copy to C. M. Blair C. E.

Mr. William MacKenzie
Superintendent, Water Department
Wallingford, Connecticut

Dear Mr. MacKenzie:

We had a full day on Monday looking over the [illegible] and discussing it with you, Messrs. Blair and Deane. The conditions found upon actually getting the excavation [illegible] somewhat different from what we anticipated from the preliminary investigations. Even with the foundation as we found it I am of the opinion that a safe permanent dam can be built, although you will have to add a little to your estimated cost and in the conference with the Public Utilities Board he seemed to understand what you were up against and ready to spend whatever was required to accomplish the above purpose. My opinion differed slightly on some things, we all agreed to agree that would be better on the east side of the dam to have a gravity [illegible] abutment and extend the concrete cutwall well into the hard [illegible] would be the sheet piling and have the cross section same as on the west side. In regard to the height of the [illegible] have contours run in order to determine which elevation would give the least shallow water around the edges. In our telephone conversation yesterday morning you gave me the information that it was your opinion that elevation 194 for the flow line instead of 196 would lessen the shallow area of the reservoir. This reservoir is going to be considered in connection with your Paug Pond supply which is by gravity. Paug Pond has a storage capacity which is larger than the ordinary design for a water shed of this size. You will naturally use the pumping station Paug Pond drops down as the supply from there does not have to be [illegible] and if I understand it correctly you will be pumping against the head caused by the elevation of Paug Pond above this supply.

Perhaps because I approve the plans with the [illegible] at elavation 196, I still think your [illegible] elevation with the proper precautions. However, with a better foundation condition at 194 I think you are justified in [illegible]

Moderately low dams have been built on [illegible] sand and gravel foundation. Sand such as you have found in the [illegible] stream is not compressible to any great extent as long as it is confined and cannot move. The steel sheeting on upper and lower edges of the [illegible] will prvent this unless the sand can be forced out under the bottom of the sheeting and up on the outside which is hardly conceivable. You [illegible] ing the

additional precaution of placing piles in the foundation in order to resist the sand foundation from settling. I think I differed with you and Mr. Blair in regard to the height to which the piles should be cut off. My idea being that they should be substantially at the level of the surface of the sand foundation where there would be no danger of their drying out and softening up. The concrete would naturally compress around them, perhaps an inch, so that the dam could not slide without moving the piles and I doubt if there would be enough pressure to slide on that material even without piles considering that the apron and everything would have to move.

You informed me that you had already moved the spillway section 5 feet to the west in order to get a little farther away from the east bank. Mr. Blair did not like to see the length of the spillway reduced which you had suggested doing. We have been in the habit of using A. H. Hill's table for spillway capacities but there have been some flood discharges in recent years which are more than used in his table. The last reservoir which the City of Norwich built had a water shed of 8 square miles and spillway was 60 feet wide with the top of the embankment 8 feet above the spillway. The embankment was quite wide on account of the fact that the dam was designed to be raised something over 15 feet at a later date. The maximum depth of water over the crest was 42" during the 15 years of its existence. All things being considered, especially in view of Mr. Blair's wishes, I think the length of the spillway should not be reduced more than 10 feet. As mentioned in the conference, the walls at foot of spillway should be made strong enough to take the beating and high enough not to be over-topped.

As mentioned above the critical design of a dam on this foundation is to be sure that the water is cut off from getting under the upper edge of the dam and also looking out for where the water leaves the hard surface of the concrete or paving. My experience has been that you will find after this dam has gone through a couple of seasons in which you should have a couple of feet of water over the spillway that there will be a hole dug below the apron where it leaves the paving. After this hole is dug for a width of 5 or 6 feet it should be filled up with loose rock dumped in. This loose rock seems to break up the force of the water so that it will not excavate the bed of the stream any further.

Mention was made of placing a layer of crushed stone over the sand bottom on which to start the concrete. I would prefer to omit this and place the concrete on the sand after it has been unwatered by having the suction end of pipe in a good sump hole. The placing of concrete should start at one side and work over toward sump in layers.

You suggested a fill in back of dam. If this could be put on in layers of impervious material and rolled with the bulldozer, it would be an added precaution. If this were done all the way across, it would probably be necessary to change intake of gate house and perhaps build a wing wall upstream from northeast corner of gate house.

The above are my ideas of the dam crudely expressed. Please be assured that I feel sure that your dam can be safely built and I know Mr. Blair feels the same.

Sincerely yours,

ERT

Hope the above does not materially differ from your ideas

ERP/EW

B-17

WALLINGFORD BOARD OF WATER COMMISSIONERS
PINE RIVER DAM

LIST OF EXTENSION STEMS FOR GATE VALVES IN GATE HOUSE WELLS

SEPTEMBER 25, 1942

NOTE: This list supercedes list of July 14, 1942

Valve	Size	Elev. of CL of Valve	Elev. of Floor	Length of Extension Stem
Blowoff	24"	171.50	199.0	25'-6"
Supply	30"	171.50	199.0	26'-6"
Intake	20"	176.00	199.0	22'-0"
Intake	20"	163.00	199.0	15'-0"
Intake	30"	169.00	199.0	9'-0"
Drain	8"	170.75	199.0	29'-4"

Note: Lengths of extension stems listed are figured from the top of coupling on the spur gear to a point 5'-0" above the floor of the gate house

THE HENRY SOUTHER ENGINEERING CO.

October 12, 1942

Wallingford Water Dept.
Wallingford
Conn.

Att. Mr. M. A. MacKenzie, C. E.

Gentlemen:

Enclosed you will find reports covering the tests on sands from Farmington Avenue, Plainville, and from Wallingford.

Both sands fail to meet the requirements of standard specifications for organic impurities in sand, the Plainville sand showing a color equivalent to ASTM Plate 3 and the Wallingford bank sand a color equivalent to ASTM Plate 2.

The Standard Specifications for Roads, Bridges and Incidental Construction of the Connecticut State Highway Department, Section 4.01, states that "Fine aggregate subjected to the colorimetric test shall not produce a color darker than Standard Plate 1."

The strength tests of these sand are below the strength obtained with Standard Ottawa sand. In a publication by the National Resources Committee on the Construction of Dams for Small Water Storage Projects, the specification for sand requires that "the strength developed shall be not less than that of Standard Ottawa sand."

It seems likely that washing of the sand to remove organic impurities may improve the strength characteristics.

Yours very truly,

THE HENRY SOUTHER ENGINEERING CO.

(signed)

ILN:RFM

B-19

October 12, 1942

Wallingford Water Department
Wallingford, Connecticut

Att. Mr. W. A. MacKenzie, Gen. Mgr.

Gentlemen:

We have the following report to make on the sample of sand submitted to this laboratory on October ost:

Sample No.

Marks Wallingford Bank Sand

Sieve Analysis	% Passing
Passing 3/8 mesh	99.0
# 4	92.0
16	81.5
50	12.0
100	2.5
200	1.0
Clay and Silt (finer than #200 sieve)	1.0
Organic Impurities	ASTM Plate # 2

Compression Strength Mix	Comp. Strength lbs. per sq. in. 7-day
Constant Water-Cement-Ratio Mortar (Ottawa sand)	11,115
Constant Water-Cement-Ratio Mortar (Sample sand)	9,105

7-day Compressive Strength Ratio to Stand. Ottawa Sand = 81.9%

This sample is apparently an unwashed sand and is too high in organic impurities for good concrete. Please note value of the compression strength ratio to Standard Ottawa sand.

Yours very truly,

THE HENRY SOUTHER ENGINEERING CO.

(signed) E. A. Sanford

EAS:RHM

STATE BOARD OF SUPERVISION OF DAMS

April 30, 1943
Wallingford, Conn.

Mr. Vincent B. Clarke, C. E.
Member, State Board of Supervision of Dams
Ansonia, Connecticut

COPY

Dear Mr. Clarke:

Mr. Toffolin of the White Oak Excavators, Inc., has started on the completion of the Pine River Dam in East Wallingford, and I am of the opinion that he will start putting in the core wall on the east or west end of the dam about the middle of next week. I should like to have you present while the core wall is being extended to obtain your opinion about same.

You no doubt remember the changes that were made and the abutment that took the place of the east gravity section of the dam. In order to conserve the steel sheeting that has been used in the past for the coffer dam, I have instructed Mr. Toffolin to use 2" plank for the core wall, and leave same in place in order to drive the 30' steel sheeting in the center of same, and start the concrete core wall over the 30' steel cut-off.

Very truly yours,

Wallingford Water Fund

William A. MacKenzie, C. E.
Superintendent

WAM:JHC

STATE OF CONNECTICUT

STATE BOARD OF SUPERVISION OF DAMS

ROOM 317, STATE OFFICE BUILDING, HARTFORD

Created by Chapter 290 of the Public Acts of 1939 to supervise dams, dikes, reservoirs and other similar structures. "All such structures, with their appurtenances, without exception and without further definition or enumeration herein, which, by breaking away or otherwise, might endanger life or property, shall be subject to the jurisdiction conferred by this act."

May 3, 1943 PLEASE REPLY TO V. B. Clarke
Ansonia

Mr. Clarence Blair
100 Crown Street,
New Haven, Conn.

Dear Sir:

For your information I am enclosing copies of recent correspondence between Mr. MacKenzie and myself. I will be glad of any suggestions you may have regarding Mr. MacKenzie's ideas. I assume the 2"wood plank would be below the water line permanently.

I am also enclosing the information form to be filled out so that I can issue a permit for the dam on Pine River which to date I have not done.

Very truly yours,

V. B. Clarke

V. B. Clarke, Member
State Board of Supervision of Dams

VBC:M
Encl.

May 4, 1945

Board of Water Commissioners
Wallingford, Connecticut

Att: Mr. P. A. Merian, Supt.

Gentlemen:

We are delivering to you today certain prints and other material in connection with your Pine River Dam.

In January of 1944 this office, under the direction of Mr. W. A. MacKenzie, prepared a final plan of the dam as built. This plan was made for the purpose of filing with the State Board of Supervision of Dams. Mr. MacKenzie retired before the plan was finished, and before he could sign it as he had intended to do.

At your request we have completed the plan, and the writer has certified as to its correctness. Of this final plan we are furnishing you two white prints on cloth, for filing with the State Board of Supervision of Dams; one blue print for the files of Mr. V. B. Clarke of Ansonia, the member of the State Board who inspected the job; and one tracing cloth lithoprint and a blue print for your own files.

We also are furnishing you four blue prints of construction plans of the dam, and a copy of the original specifications. These specifications and the contract were amended and added to several times during the progress of the work.

We are returning a map entitled "Map of Storage Reservoir on Muddy River" which Mr. MacKenzie had loaned to us in connection with the highway layout, and a field notebook which he wanted us to use for some of the work we did under his direction.

We are writing this letter so that there will be a record of this transaction.

Please feel free to call on us if we can be of any further assistance to you.

Very truly yours,

CLARENCE BLAIR ASSOCIATES, INC.

B-13

APPENDIX C

DETAIL PHOTOGRAPHS

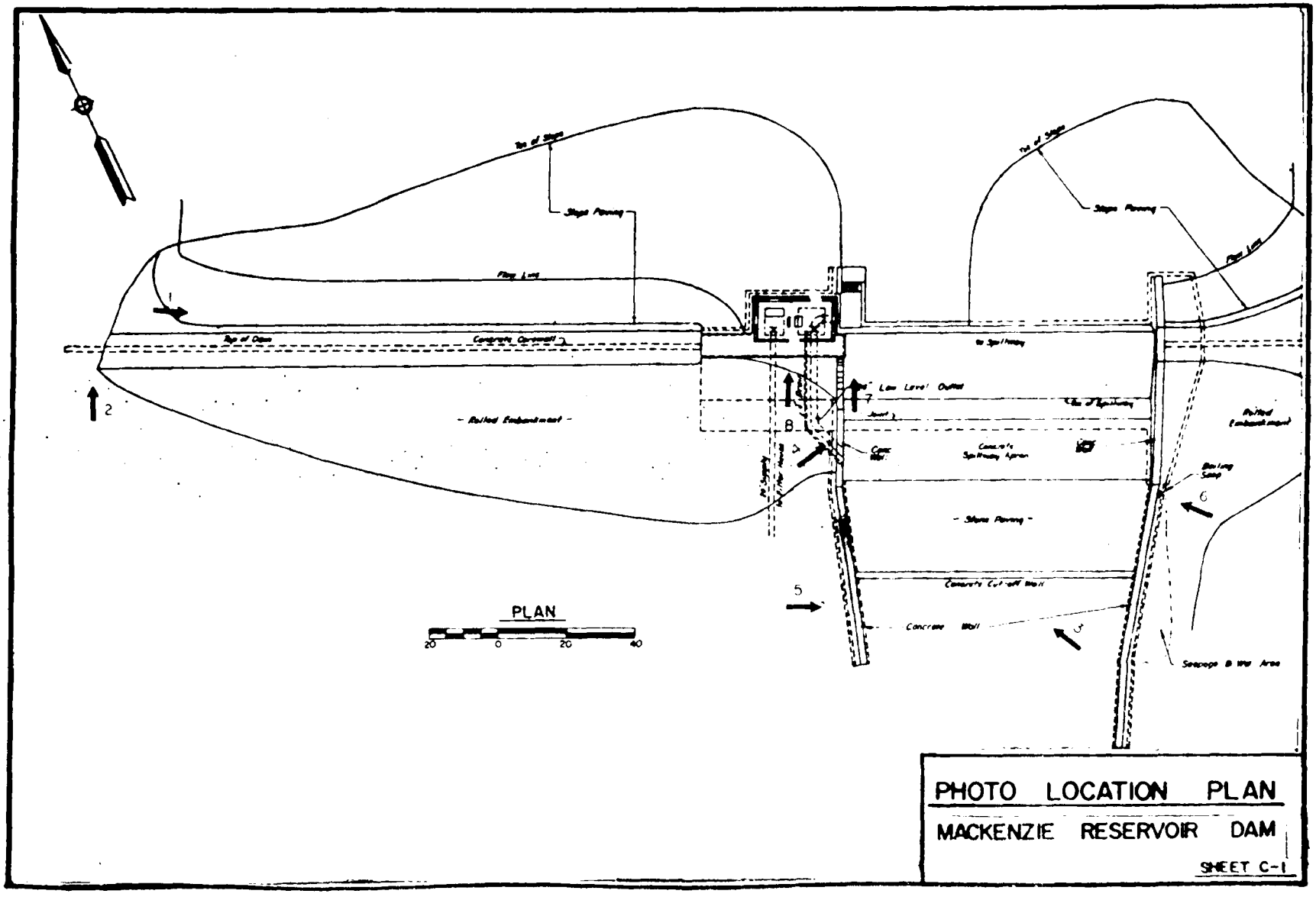

PLAN
20 0 20 40
PHOTO LOCATION PLAN
MACKENZIE RESERVOIR DAM
SHEET C-1

PHOTO 1 - Crest of dam and upstream slope riprap (May, 1979).

PHOTO 2 - Crest of dam at right abutment. Note low area on the left side of photo and mound of dirt at center (August, 1979).

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Mackenzie Reservoir Dam Muddy River Wallingford, Connecticut CT # 27 660 KB DATE Aug '79 PAGE A-1
CAHN ENGINEERS INC WALLINGFORD, CONN ENGINEER		

PHOTO 3 - Downstream slope, spillway channel and gatehouse structure. Note wet area below horizontal construction joints (August, 1979).

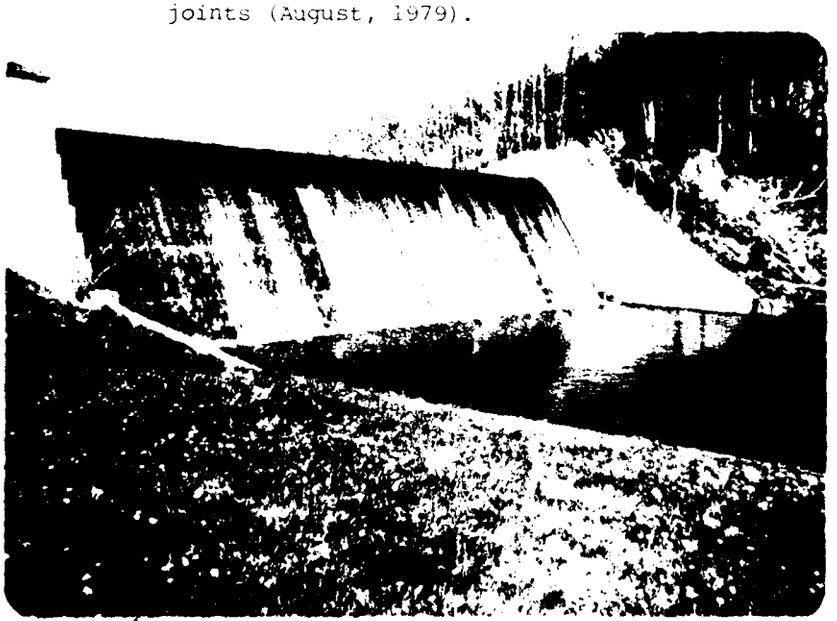


PHOTO 4 - Spillway and spillway training walls. Seepage at far right of photograph (May, 1979).

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Mackenzie Reservoir Dam Muddy River Wallingford, Connecticut CE # [illegible] DATE Aug [illegible] PAGE [illegible]
CAHN ENGINEERS INC WALLINGFORD, CONN ENGINEER	INSPECTION OF NON-FED. DAMS	

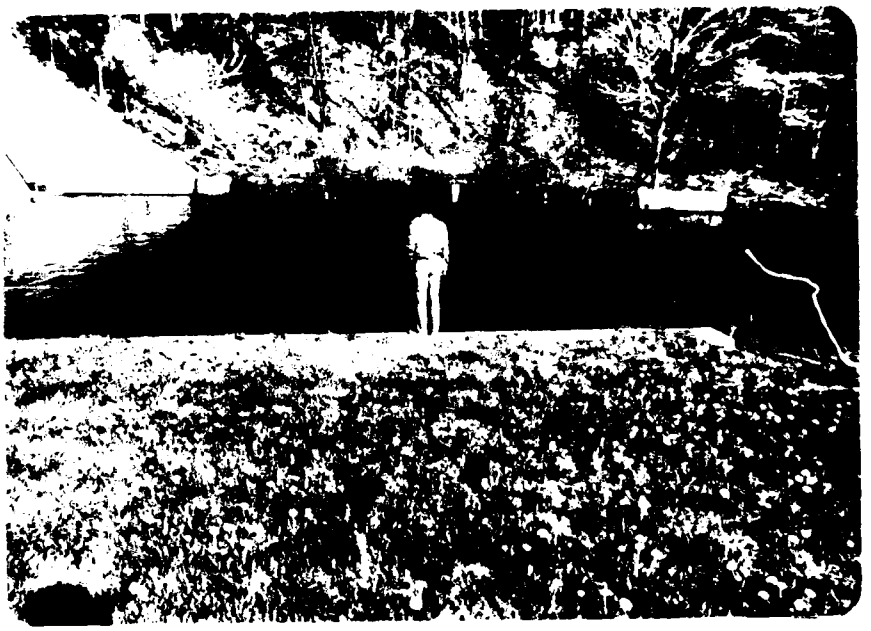


PHOTO 5 - Seepage at left spillway training wall and trees growing on downstream slope. Left embankment. Note brown color of seepage spot (May, 1978).

PHOTO 6 - Closeup of seepage at left spillway training wall (May, 1978).

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	[illegible] Reservoir Dam Miami River [illegible] CE # [illegible] DATE [illegible] PAGE [illegible]
CAHN ENGINEERS INC WALLINGFORD, CONN ENGINEER		

PHOTO 8 - Cracking and efflorescence of concrete on catchbasin downstream wall (May, 1979).

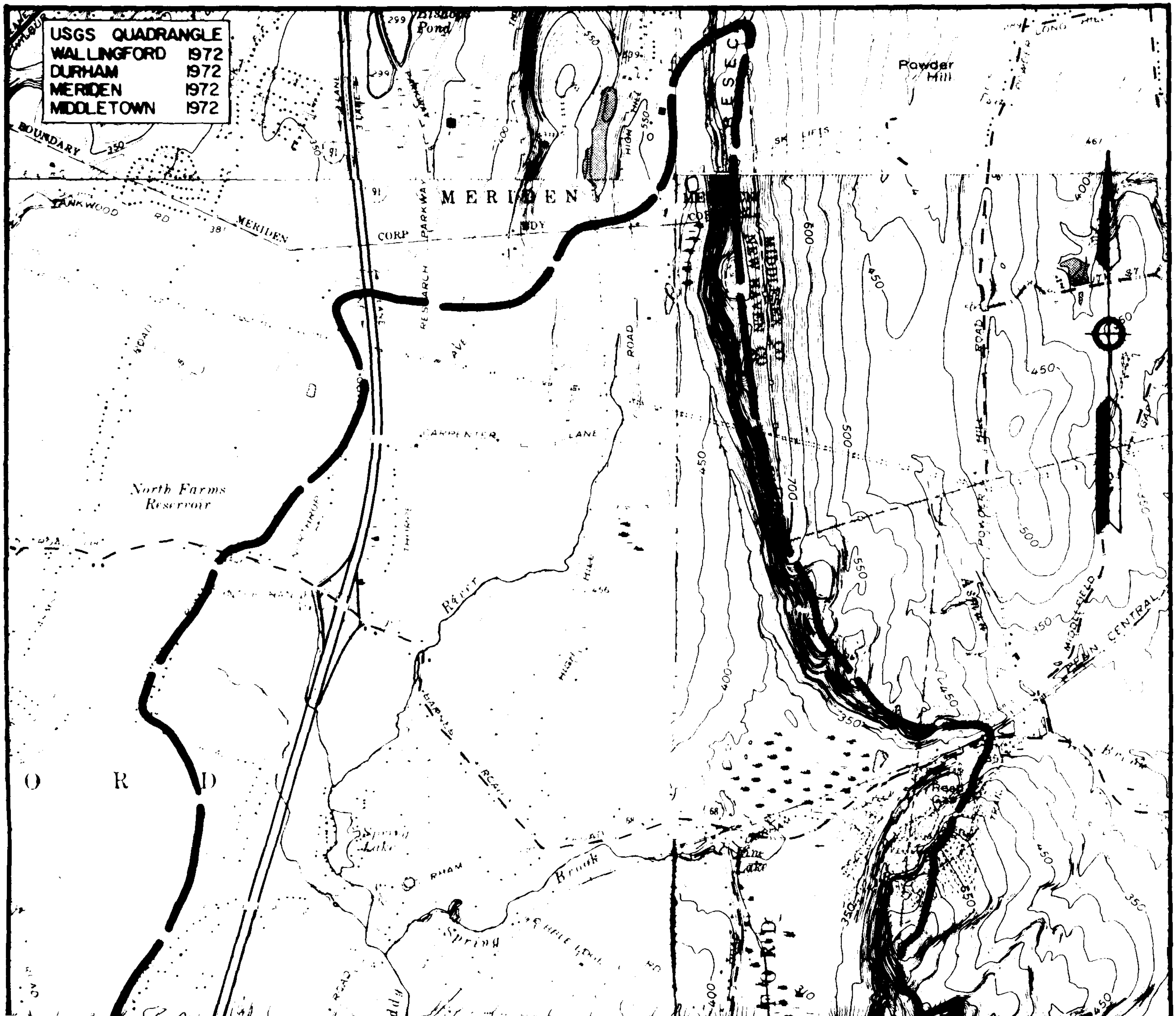
US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Mackenzie Reservoir Dam Muddy River Wallingford, Connecticut
CAHN ENGINEERS INC WALLINGFORD, CONN ENGINEER	INSPECTION OF NON-FED. DAMS	CE # 27 660 Kb DATE Aug '79 PAGE C-44

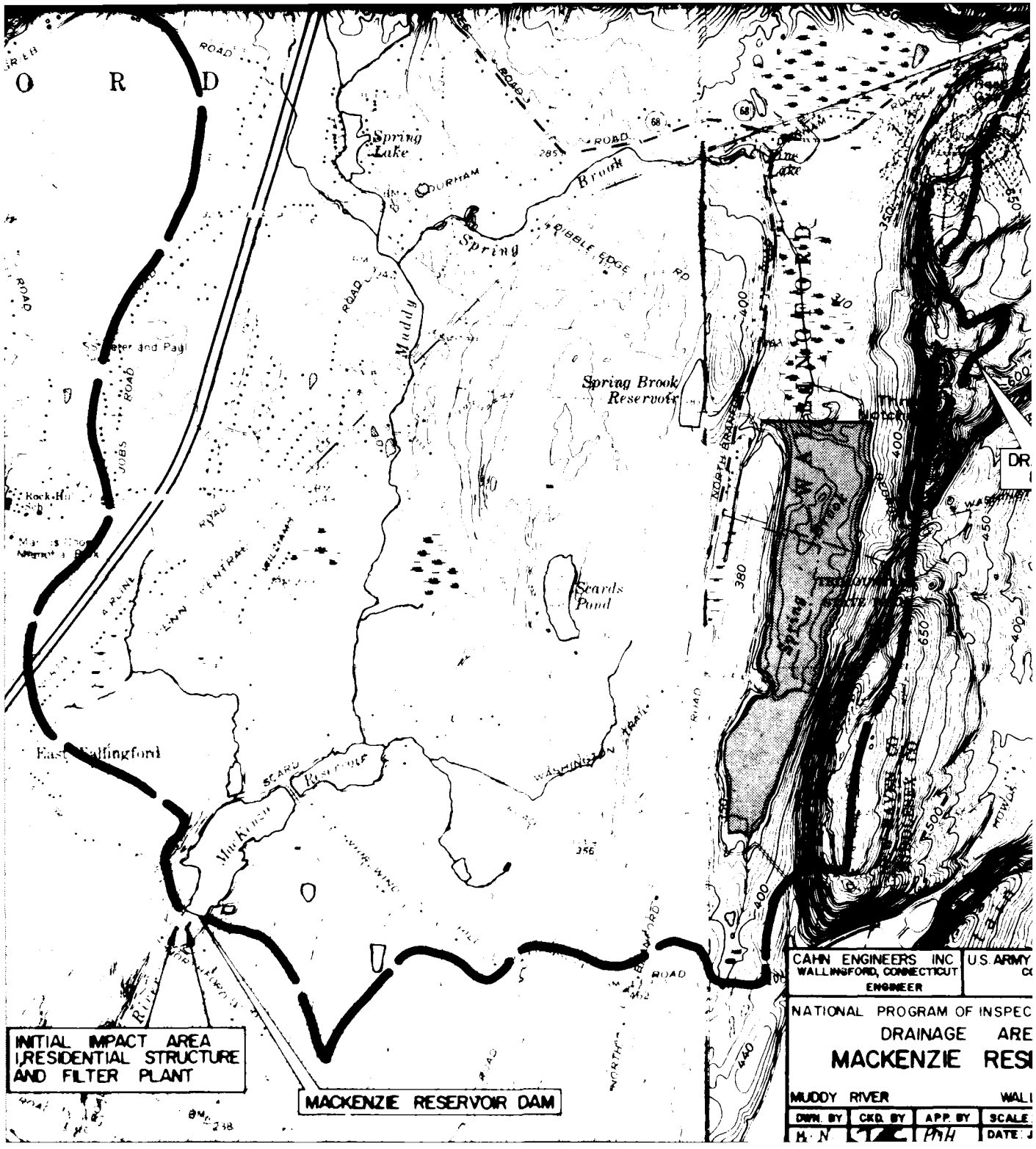
APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS

APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS


USGS QUADRANGLE
WALLINGFORD 1972
DURHAM 1972
MERIDEN 1972
MIDDLETOWN 1972
Powder Hill
Bishops Pond
MERIDEN
CORP
BDY
BOUNDARY
MERIDEN
RESEARCH
PARKWAY
CARPENTER
LANE
North Farms Reservoir
POWDER
HILL
ROAD
MIDDLESEX CO
NEW HAVEN CO
PENN CENTRAL
MIDDLEFIELD
River
Brook
Spring Lake
O R D
SK LIFTS


Spring Lake
Spring Brook Reservoir
Muddy Brook
Scards Pond
Muddy River
INITIAL IMPACT AREA
1 RESIDENTIAL STRUCTURE
AND FILTER PLANT
MACKENZIE RESERVOIR DAM
CAHN ENGINEERS INC
WALLINGFORD, CONNECTICUT
ENGINEER
U.S. ARMY
NATIONAL PROGRAM OF INSPEC
DRAINAGE ARE
MACKENZIE RESI
MUDDY RIVER
DWN. BY
CKD. BY
APP. BY
SCALE
DATE

Dahn Engineers inc. Consulting Engineers

Project _____ Sheet _____ of _____

Computed By _____ Checked By _____ Date _____

Field Book Ref _____ Other Refs _____ Revisions _____

HYDRAULIC & HYDROLOGIC INVESTIGATION

[illegible] DETENTION, [illegible]

I. TERRAIN [illegible] TEST FIELD CONDITIONS

II. [illegible] PROBABLE FLOOD

III. WATERSHED CLASSIFIED AS [illegible]

IV. WATERSHED AREA

MIDDLE BRANCH IS DIVERTED BY A DAM AND DIKE TO AN EMBANKMENT WITH A BOX CULVERT. THE CENTER LINE OF THE INVERT OF THE [illegible] IS [illegible] HAS A SURFACE ELEVATION OF [illegible] WALL ELEVATION [illegible] RESERVOIR WATERSHED AND CONTROLS THE FLOW [illegible] INTO THE [illegible]

ISLAND ROAD CROSSES THE [illegible] EMBANKMENT WITH A 60" CONCRETE PIPE. THIS CONTROLS A VERY SMALL PORTION OF THE TOTAL DRAINAGE AREA INTO THE LOWER PORTION OF THE RESERVOIR

A. TOTAL D.A. = 3.92 Sq. Mi.*

B. D.A. D/S FROM [illegible] ROAD [illegible] 3.7 Sq. Mi.

C. D.A. D/S FROM WHITEVIEW HILL ROAD CROSSING 0.22 Sq. Mi.

* DATA FROM USGS HARTFORD [illegible] QUAD SHEET WALLINGFORD

CONTOUR [illegible]

D-1

Cahn Engineers Inc. Consulting Engineers

Project [illegible] Sheet [illegible] of [illegible]
Computed By [illegible] Checked By JAC
Field Book Ref [illegible] Other Refs [illegible] Revisions [illegible]

MACKENZIE RESERVOIR

a. [illegible] MAXIMUM PROBABLE [illegible]

AS A RESULT OF [illegible]
ENTIRE WATERSHED WOULD BE USED

b. SPILLWAY DESIGN FLOOD (SDF)

1) CLASSIFICATION OF DAM ACCORDING TO [illegible]
GUIDELINES

a) SIZE * STORAGE (MAX) = 410 AC-FT (1000 AC-FT [illegible]
SIZE = HEIGHT = 35' (25 < H < 40) SEE P. 15

b) HAZARD POTENTIAL

THE DAM IS LOCATED JUST DOWNSTREAM FROM A WATER TREATMENT PLANT AND A FEW MILES UP THE MOOSE RIVER CHANNEL BETWEEN MACKENZIE RESERVOIR AND THE COMMUNITIES OF NORTHFIELD AND CLINTONVILLE IS SPARSELY POPULATED. [illegible] ANY STRUCTURES CLOSER THAN 50' ABOVE BED. THE OUTSKIRTS OF NORTHFIELD AND CLINTONVILLE HAVE [illegible] ABOVE THE BED.

* STORAGE - WALLINGFORD WATER AND SEWER DEPT. [illegible] CAPACITY = 1600 MG AT SPILLWAY [illegible] AND THE "ESTIMATED BASE OF SPILLWAY" DAM [illegible] GAUGES COMMISSION GIVES A CAPACITY OF [illegible] 225 MG (1973 RECORDS). THE INTENTION OF DAMS [illegible] RECREATIONAL USE WILL USE [illegible] FAST WALLINGFORD WATER & SEWER DEPT MAY WANT TO DRAIN [illegible]

D-3

MACKENZIE RESERVOIR DAM

2a CONT'D) CLASSIFICATION:

DREDGE RESERVOIR AT A LATER DATE. IT WILL HAVE LARGE CAPACITY BASED ON AVG OF SURFACE AREAS AT FLOW LINE (EL 194' MSL) AND TOP OF DAM (EL 199.5' MSL).
55 Ac × 5.5' ≈ 300 Ac-ft ∴ S_{max} = 770 + 300 = 1070 Ac-ft

4) SIZE - INTERMEDIATE

HAZARD - HIGH

3) SURCHARGE AT PEAK INFLOW

a) PEAK INFLOW - Q_P = PMF 15200 cfs Q'_{PI} ½ PMF 7600

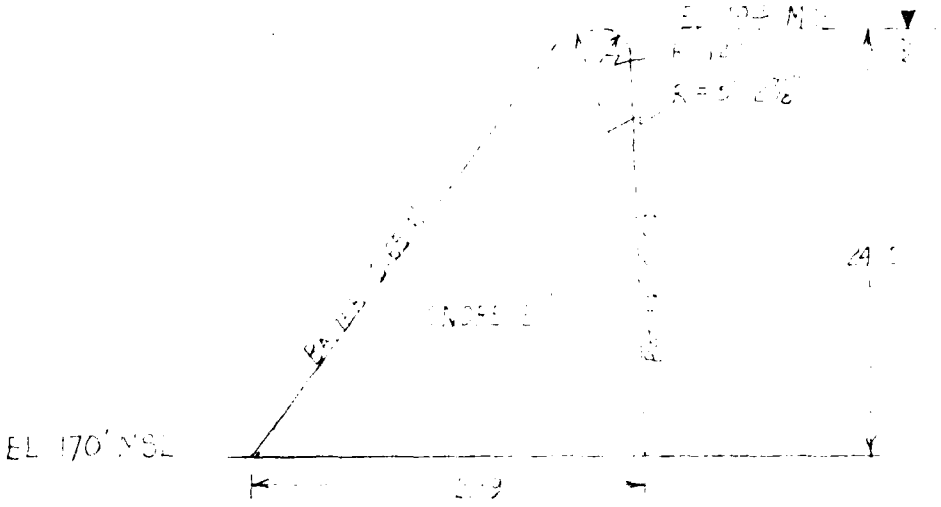
b) SPILLWAY (OUTFLOW) RATING CURVE

1) SPILLWAY

THE SPILLWAY IS A BROAD CRESTED OGEE WEIR WITH SIDE CURVES AT THE CREST (SEE SKETCH PG 5). THE D/S FACE IS A 1" TO 1⅝" BATTER FROM THE BASE TO A POINT 9' [illegible] THE CREST WHERE IT TERMINATES IN A RADIUS OF CURVATURE R=12". THE D/S FACE IS ON A 2" TO 3" BATTER FROM THE BASE (EL 170) TO JUST SHORT OF THE CREST WHERE IT TERMINATES IN A RADIUS OF CURVATURE OF R= 5' - 2⅞".
IN PLAN THE LENGTH OF THE SPILLWAY CREST IS L=90'. THE HEIGHT BETWEEN THE CREST OF THE WEIR (EL 194.5 MSL) AND THE TOP OF THE DAM (EL 199.5) IS 5.5'.

MACKENZIE RESERVOIR DAM

3E CONT'D) SPILLWAY OUTFLOW RATING CURVE



1. SPILLWAY CREST ELEVATION, ASSUME EL = 170'

USING THE CREST ELEVATION AS DATUM [illegible] THE DISCHARGE IS APPROXIMATED BY

$Q_s = [illegible]$

2) EXTENSION OF RATING CURVE FOR SURCHARGE HEADS ABOVE TOP OF DAM

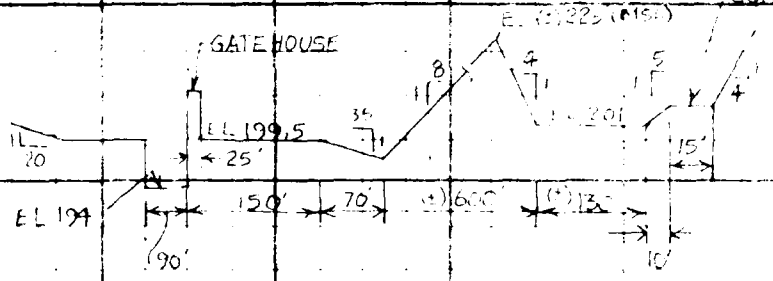
THE DAM IS AN EARTH FILL DAM OF [illegible] WITH 2H TO 1V D/S SLOPE AND 2H TO 1V U/S SLOPE. THE EMBANKMENT EXCLUDING SPILLWAY IS [illegible] LONG TOP @ EL 190'± MSL. THE EMBANKMENT ON THE RIGHT END OF THE DAM [illegible] AND THEN RISES AGAIN 8H TO 1V. THE [illegible] IT RISES TO AN ELEVATION OF [illegible] AND THE [illegible]

Dahn Engineers Inc. — Consulting Engineers

Project NON-FEDERAL DAM INSPECTION — Sheet 6 of 12
Computed By RK — Checked By JHC — Date 11-23-82
Field Book Ref ____ — Other Refs ____ — Revisions ____

MACKENZIE RESERVOIR DAM

DIKE ON A SLOPE OF 4H TO 1V. THE DIKE IS (+)330 FEET LONG AT EL 201 MSL) THE RIGHT SIDE OF THE DIKE RISES TO (+)[illegible] TO SCARD ROAD (SURFACE @ (+)203' MSL) THE TERRAIN AT THE RIGHT SIDE OF SCARD ROAD RISES 4H TO 1V TO A MAXIMUM ELEVATION OF (+)300' MSL. THE TERRAIN ON THE LEFT SIDE OF THE DAM RISES 20H TO 1V ON THE RIGHT SIDE OF THE SPILLWAY THERE IS A GATEHOUSE STRUCTURE MEASURING 25'H BY 11'V.



ASSUME C = 3.0 FOR THE EARTH EMBANKMENT
C = 2.5 FOR TERRAIN AT SIDES OF DAM AND DYKE
C = 3.0 FOR DIKE EMBANKMENT

ASSUME EQUIVALENT LENGTHS FOR SIDES OF THE DAM, EMBANKMENT AND DYKE AS FOLLOWS

1) TOP OF DAM L_D = 125' + 25' + 90' ; $Q_D = [3.0(H-5.5)]^{3/2} + 7.5(H-5)$

SLOPING PORTION OF DAM

a) FROM $0 < H \leq 5.5$ $Q_D' = (2/3)(25')\sqrt{H-5.5}\,(H-5.5)^{3/2}$ = 7.5(H-5)

FROM $H > 5.5$ $Q_D'' = (3.0)(10)(H-4)^{3/2}$

$Q_D'' = Q_D'$ WHEN $H = 5.5$

MACKENZIE RESERVOIR DAM

3b CONT'D) OUTFLOW RATING CURVE

(c) TERRAIN TO RIGHT SIDE OF DAM

a) RISE TO CREST $L_R = 2/3(4/1)(H-7)^{3/2}$ $Q_R = 3.1(H-7)^{3/2}$

b) DESCEND TO DYKE $(L'_R)_1 = 1.3(4/1)(H-7)^{3/2}$ $(Q'_R)_1 = 6.1(H-7)^{3/2}$

c) FLAT PORTION OF DYKE $(L'_R)_2 = (3.0)(10)(H-7)^{3/2}$ $(Q'_R)_2 = 31(H-7)^{3/2}$

d) RISE TO SCARP ROAD

FROM $H=7$ TO $H=9$ $(L'_R)_3 = (2/3)(4/1)(H-7)^{3/2}$ $(Q'_R)_3 = 6.1(H-7)^{3/2}$

FROM $H>9$ $(L''_R)_3 = (2.5)(10)(9-7)^{3/2}$

$(Q''_R)_3 = (Q'_R)_3$ WHEN $H=9$ $\therefore 25(9-7)^{3/2} = (Q'_R)_3$

e) FLAT PORTION OF SCARP ROAD

(ASSUME $C=3.0$) $(L'_R)_4 = 5.5(H-9)$ $(Q'_R)_4 = 16.5(H-9)^{3/2}$

f) SLOPING TERRAIN TO RIGHT SIDE OF DAM ROAD

$(L'_R)_5 = (2/3)(4/1)(H-9)^{5/2}$, $(Q_R)_5 = 67(H-9)^{5/2}$

(d) TERRAIN TO LEFT SIDE OF DAM $L'_L = 2/3(20/1)(H-5.5)^{3/2}$

$Q'_L = 33(H-5.5)^{5/2}$

THEREFORE, THE TOTAL OUTFLOW CURVE CAN BE

APPROXIMATED BY: $Q = Q_R + Q_L + [(Q'_R)_1 + (Q'_R)_2 + [(Q_R)_3 \text{ OR } (Q''_R)_3] + (Q'_R)_4 + (Q_R)_5 + Q_L$

MACKENZIE RESERVOIR DAM

3) SPILLWAY CAPACITY TO TOP OF DAM

H = 5.5' Q_s = 4300 CFS (1) 28% OF Q_{PF} (2) 56% OF Q_{PF}

D) SURCHARGE HEIGHT TO PASS Q_{PF}

a) @ Q_{PF} = PMF = 15200 CFS H = 9.6

b) @ Q_{PF} = 1/2 PMF = 7600 CFS H = 6.7

4) EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE FLOOD (ROUTEFLOW)

a) RESERVOIR AREA AT FLOW LINE * A_o = 47 Ac

* FROM COMPUTATIONS OF THE RESERVOIR CAPACITY

SA @ FLOW LINE 47 Ac FROM USGS
SA @ EL 220 45 Ac
SA @ EL 210 = 47 Ac

∴ ASSUME AVERAGE SA TOTAL FOR EXPECTED RANGE OF SURCHARGE

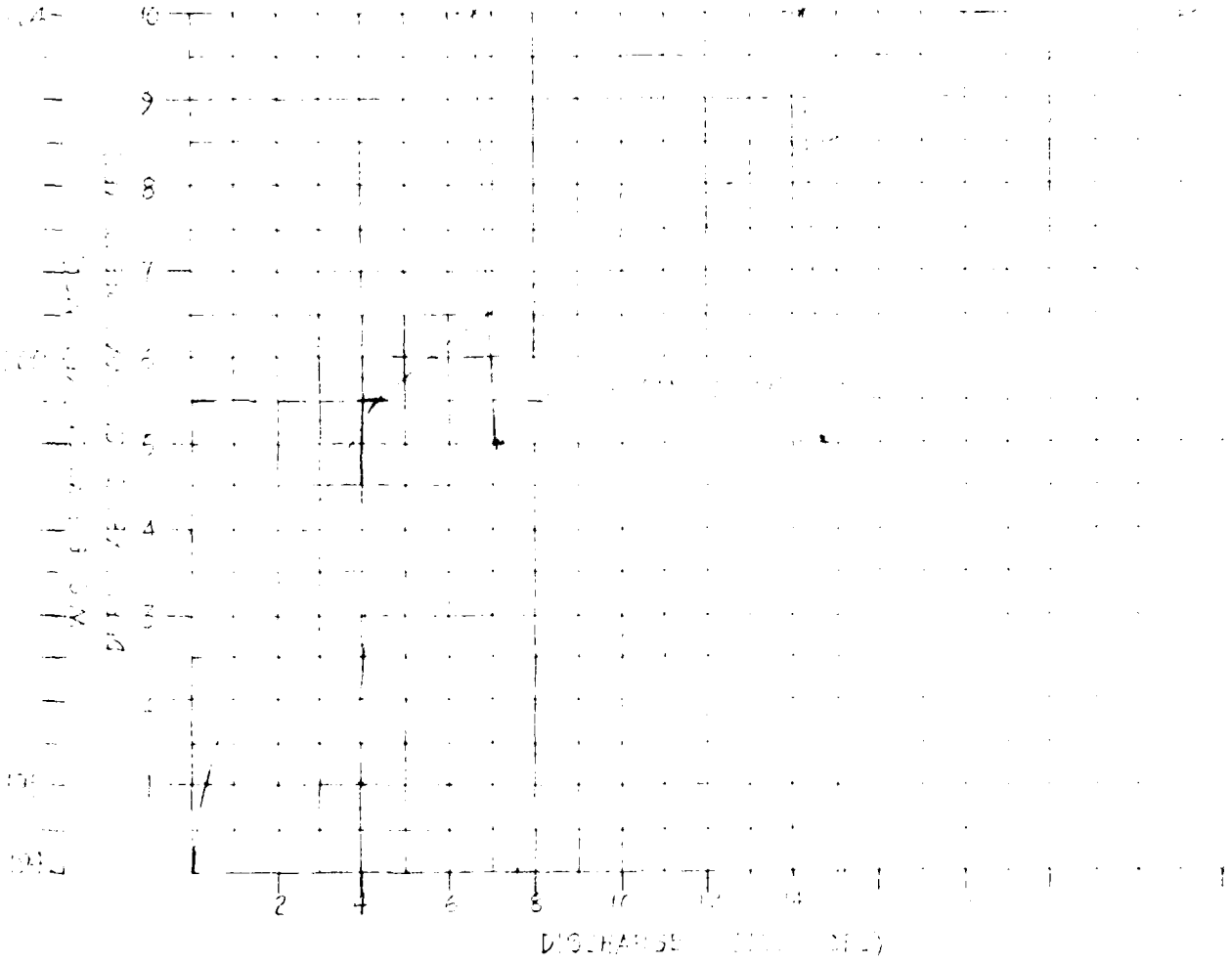
Cahn Engineers Inc.

Consulting Engineers

Project _____ Sheet 2 of _____

Computed By _____ Checked By _____ Date _____

Field Book Ref _____ Other Refs _____ Revisions _____



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Consulting Engineers

Project _____ Sheet _____ of _____

Computed By _____ Checked By _____ Date _____

Field Book Ref _____ Other Refs _____ Revisions _____

Cahn Engineers Inc. Consulting Engineers

Project _____ Sheet _____

Computed By _____ Checked By _____ Date _____

Field Book Ref _____ Other Refs _____ Revisions _____

Cahn Engineers Inc. Consulting Engineers

Project [illegible] DAM INSPECTION
Sheet [illegible] of [illegible]

Computed By [illegible]
Checked By [illegible]
Date [illegible]

Field Book Ref ____
Other Refs ____
Revisions ____

[illegible] DAM

II) DOWNSTREAM FAILURE HAZARD

a) BREACH WIDTH

1) MID HEIGHT (?) ELEV. 165 [illegible] * [illegible]

2) APPROX MID HEIGHT LENGTH [illegible] [illegible]

3) BREACH WIDTH [illegible] DAM FAILURE [illegible]

W = 0.40 × 230 = 92 [illegible] ASSUME W_b 90'

b) PEAK FAILURE OUTFLOW (Q_p)

ASSUME SURCHARGE TO TOP OF DAM, THEREFORE

[illegible] HEIGHT AT TIME OF FAILURE = Y_o = 30'

[illegible] SPILLWAY DISCHARGE ≈ 4000 [illegible]

[illegible] BREACH OUTFLOW (Q_b)

BECAUSE OF HIGH TAILWATER [illegible] [illegible]
FAILURE THE ACTUAL HEAD [illegible] THE PEAK
FAILURE OUTFLOW WILL BE APPROXIMATELY h_o = [illegible]

* NOTE FROM CLARENCE M. [illegible] DWG [illegible] WATER DEPARTMENT [illegible]
WALLINGFORD, PLAN OF DAM [illegible] RIVER WALLINGFORD, CONN. [illegible]
HEIGHT [illegible] 30'

Dahn Engineers Inc. Consulting Engineers

Project [illegible] DAM INSPECTION — Sheet [illegible] of [illegible]
Computed By [illegible] — Checked By [illegible] — Date [illegible]
Field Book Ref [illegible] — Other Refs [illegible] — Revisions [illegible]

MACKENZIE DETENTION DAM

2. CONT'D) PEAK FAILURE OUTFLOW

a) BREACH OUTFLOW (Q_b)

$Q_b = (8/27) W_b \sqrt{g}\, h_o^{3/2} \approx 14{,}000$ CFS

b) PEAK FAILURE OUTFLOW (Q_p) $Q_p = Q_s + Q_b = 4300 + 12{,}500 \approx$ [illegible]

c) RAISE IN STAGE ABOVE TAILWATER IMMEDIATELY DOWNSTREAM DAM

$Y = 0.44\, h_o \approx 8.4'$

d) APPROXIMATE STAGE JUST BEFORE FAILURE

1) $Q = Q_s = 4300$ cfs.

THE CHANNEL JUST BELOW THE DAM IS IN A SLOPE OF APPROXIMATELY 0.0050 FROM (1) 15" IN A DISTANCE OF (1) 1350". THE TERRAIN SLOPES APPROXIMATELY 8" TO 1' TO THE RIGHT OF THE CHANNEL AND 5" TO 1' TO THE LEFT.

2) STAGE FOR Q_s — $Y_s = 10.4$ FOR $Q_s = 4300$ CFS

e) FLOOD STAGE AFTER FAILURE AT CHANNEL (3) 7000" DOWNSTREAM DAM (IMMEDIATE IMPACT AREA)

$Y_p \approx 17.0'$ FOR $Q_p = 17000$ CFS

f) RAISE IN STAGE IN IMMEDIATE IMPACT AREA

$\Delta Y = Y_p - Y_s \approx 6.6'$

Cahn Engineers Inc. Consulting Engineers

Project [illegible] DAM INSPECTION
Computed By [illegible] Checked By [illegible]
Field Book Ref _____ Other Refs _____

Sheet [illegible] of [illegible]
Date [illegible]
Revisions _____

MACKENZIE RESERVOIR DAM

1. SUMMARY

a) PEAK FAILURE OUTFLOW Q_f = [illegible]

b) RAISE IN STAGE JUST [illegible]

c) APPROXIMATE STAGE BEFORE FAILURE [illegible]

d) APPROXIMATE STAGE AFTER FAILURE AT IMMEDIATE [illegible]

$Y_p = 17.0'$

e) RAISE IN STAGE AT IMMEDIATE [illegible]

$\Delta Y = 17.0 - 10.4 = 6.6'$

PRELIMINARY GUIDANCE
FOR ESTIMATING
MAXIMUM PROBABLE DISCHARGES
IN
PHASE I DAM SAFETY
INVESTIGATIONS

New England Division
Corps of Engineers

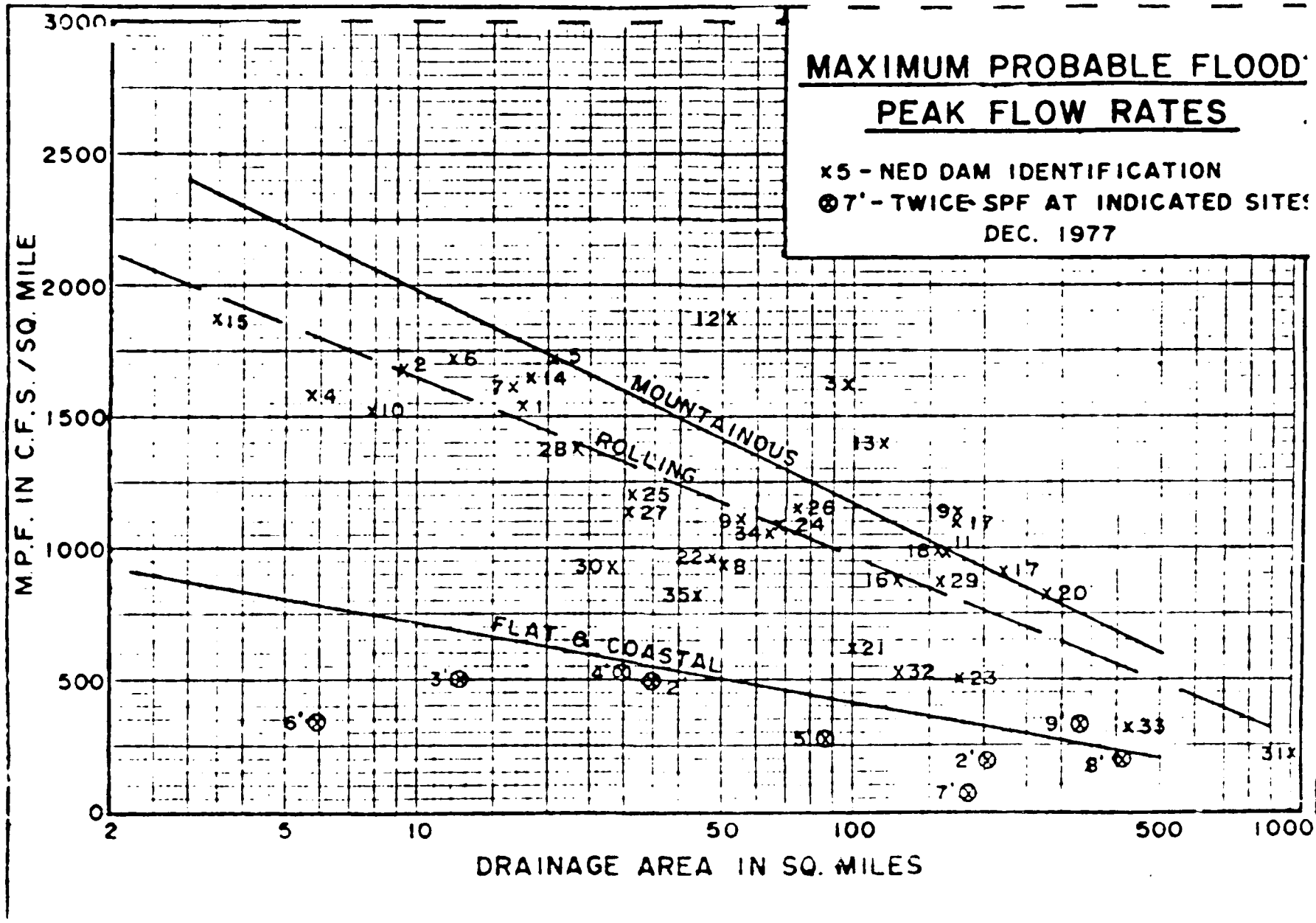
March 1978

MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

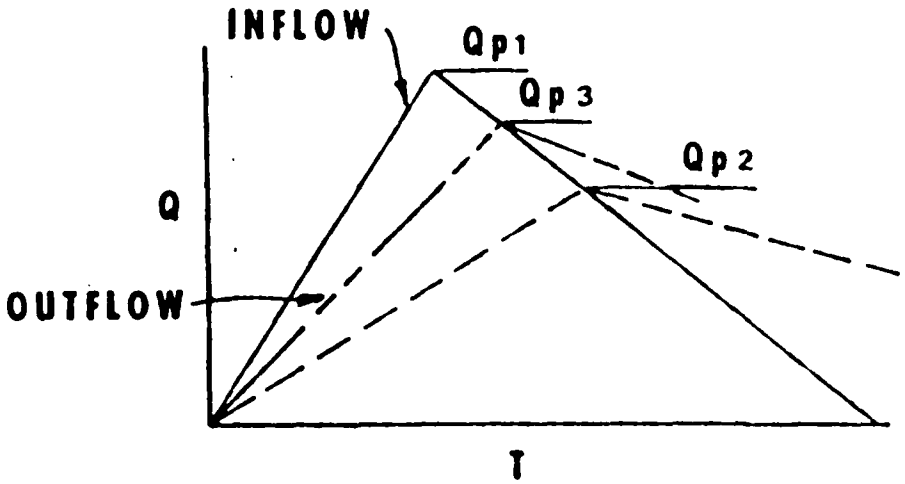
	Project	Q (cfs)	D.A. (sq. mi.)	MPF cfs/sq. mi.
1.	Hall Meadow Brook	26,600	17.2	1,546
2.	East Branch	15,500	9.25	1,675
3.	Thomaston	158,000	97.2	1,625
4.	Northfield Brook	9,000	5.7	1,580
5.	Black Rock	35,000	20.4	1,715
6.	Hancock Brook	20,700	12.0	1,725
7.	Hop Brook	26,400	16.4	1,610
8.	Tully	47,000	50.0	940
9.	Barre Falls	61,000	55.0	1,109
10.	Conant Brook	11,900	7.8	1,525
11.	Knightville	160,000	162.0	987
12.	Littleville	98,000	52.3	1,870
13.	Colebrook River	165,000	118.0	1,400
14.	Mad River	30,000	18.2	1,650
15.	Sucker Brook	6,500	3.43	1,895
16.	Union Village	110,000	126.0	873
17.	North Hartland	199,000	220.0	904
18.	North Springfield	157,000	158.0	994
19.	Ball Mountain	190,000	172.0	1,105
20.	Townshend	228,000	106.0(278 total)	820
21.	Surry Mountain	63,000	100.0	630
22.	Otter Brook	45,000	47.0	957
23.	Birch Hill	88,500	175.0	505
24.	East Brimfield	73,900	67.5	1,095
25.	Westville	38,400	99.5(32 net)	1,200
26.	West Thompson	85,000	173.5(74 net)	1,150
27.	Hodges Village	35,600	31.1	1,145
28.	Buffumville	36,500	26.5	1,377
29.	Mansfield Hollow	125,000	159.0	786
30.	West Hill	26,000	28.0	928
31.	Franklin Falls	210,000	1000.0	210
32.	Blackwater	66,500	128.0	520
33.	Hopkinton	135,000	426.0	316
34.	Everett	68,000	64.0	1,062
35.	MacDowell	36,300	44.0	825

MAXIMUM PROBABLE FLOWS
BASED ON TWICE THE
STANDARD PROJECT FLOOD
(Flat and Coastal Areas)

River	SPF (cfs)	D.A. (sq. mi.)	MPF (cfs/sq. mi.)
1. Pawtuxet River	19,000	200	190
2. Mill River (R.I.)	8,500	34	500
3. Peters River (R.I.)	3,200	13	490
4. Kettle Brook	8,000	30	530
5. Sudbury River.	11,700	86	270
6. Indian Brook (Hopk.)	1,000	5.9	340
7. Charles River.	6,000	184	65
8. Blackstone River.	43,000	416	200
9. Quinebaug River	55,000	331	330


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
MOUNTAINOUS
ROLLING
FLAT & COASTAL
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Qp_1) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Qp_1".

b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Qp_3".

SURCHARGE STORAGE ROUTING SUPPLEMENT

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Avg "$STOR_1$" and "$STOR_2$" and Compute "Qp_3".

c. If Surcharge Height for Qp_3 and "$STOR_{AVG}$" agree O.K. If Not:

STEP 4: a. Determine Surcharge Height and "$STOR_3$" To Pass "Qp_3"

b. Avg. "Old $STOR_{AVG}$" and "$STOR_3$" and Compute "Qp_4"

c. Surcharge Height for Qp_4 and "New $STOR_{Avg}$" should Agree closely

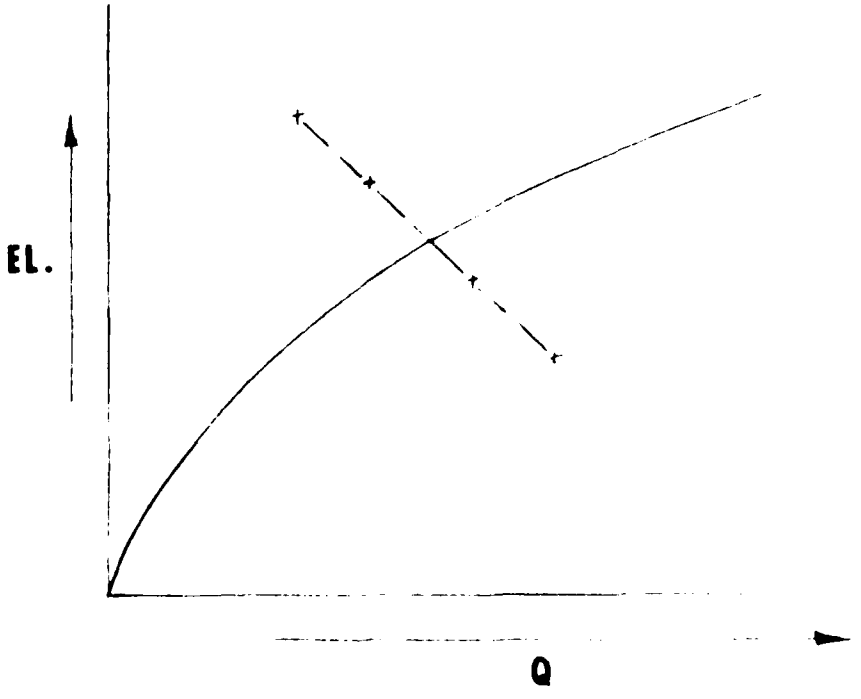
SURCHARGE STORAGE ROUTING ALTERNATE

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR}{19}\right)$$

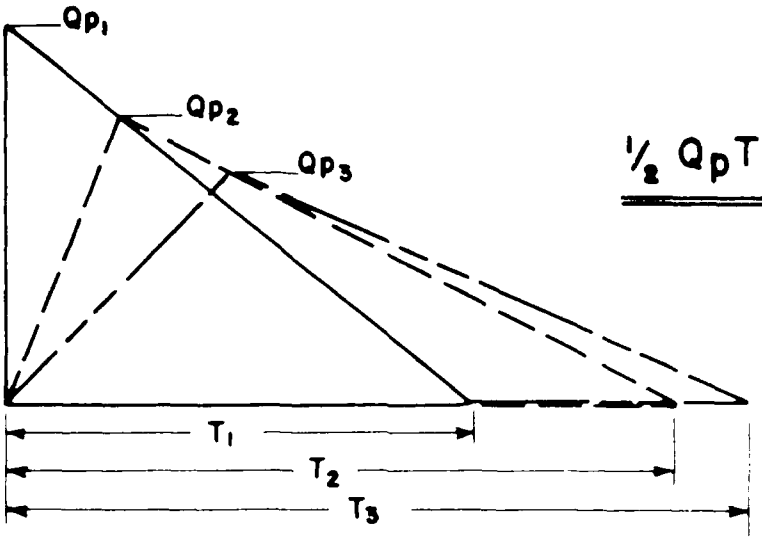
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

FOR KNOWN Q_{p1} AND 19'' R.O.

Q_{p2}	STOR	EL.



"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Qp_1 = \frac{8}{27} W_b \sqrt{g} Y_o^{\frac{3}{2}}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOMPANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Qp_2(TRIAL) = Qp_1 (1 - \frac{V_1}{S})$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Qp_2 = Qp_1 (1 - \frac{V_{AVG}}{S})$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
CT	31	NED	CT	009	03				MACKENZIE RESERVOIR DAM	4126.2	7246.7	31AUG79

POPULAR NAME	NAME OF IMPOUNDMENT
	MACKENZIE RESERVOIR

REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 07	MUDDY RIVER	NORTH BRANFORD	2	11000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REPG	1944	S	60	30	1100	770	NED	N	N	N	N	

REMARKS

21-CONCRETE COREWALL & SPILLWAY

U.S. HAS	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	425 U 90	4300												

OWNER	ENGINEERING BY	CONSTRUCTION BY
TOWN OF WALLINGFORD	CLARENCE M BLAIR INC	

REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
CAHN ENGINEERS INC	02MAY79	PL 92-367

REMARKS

54-AND 9AUG79